THE

LOGIC OF SCIENCE:

A TRANSLATION

OF THE

POSTERIOR ANALYTICS OF ARISTOTLE,

WITH NOTES AND AN INTRODUCTION.

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PREFACE.

There is a pretty general agreement among those who have devoted any attention to Logic, that the Logical works of Aristotle would repay the labour of a perusal. In spite, however, of this opinion, it does not appear that the pages of the Organon are often turned over by very diligent hands. Nor is this very difficult to be accounted for, if we consider their obscurity—a quality, indeed, which they share with most of Aristotle's productions. It was to facilitate the study of the original that this translation of a portion of it was undertaken: and the Posterior Analytics was the portion selected, both because it is intrinsically the most valuable, as affording the greatest insight into Aristotle's views, and bringing him on to the same ground with modern writers on the Philosophy of Science; and because the remaining parts are already tolerably well known through the works of the Scholastic logicians, while this, though far more interesting to a student of the Baconian Logic, has been comparatively neglected. In the Introduction a sketch has been given of the whole of the Organon.

ERRATA.

Page 18, Note [2] *for* ἡ μέσους τινός. *read* ἡ μέρους τινός.
—— 47, Note [2] *for* System of Logic, BOOK II. *read* System of Logic, BOOK III.
—— 113, Note [1] *for* The conclusion deducted, *read* The conclusion deduced.
—— 114, *for* CHAPTER XII. *read* CHAPTER XI.
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ADDENDUM.

Page 4, to Note [1], *add* πᾶσα γὰρ ἐπιστήμη καὶ δύναμις τοῦ βελτίστου δοκεῖ εἶναι. Topics, vi. 5.

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INTRODUCTION.

SKETCH OF THE ORGANON.

§ 1. In every Science may be found some general problem, to the complete solution of which all its inquiries converge; some central idea that unites all its members in an organic whole, however great their variety. It is by the Idea alone that we can determine into how many branches an inquiry should be divided, and what is the relative importance of these branches; what investigation is essential to the science, and what is nugatory or extraneous.

The development of a particular Idea, curiosity to solve a particular problem, is not a matter of accident in the history of individuals or of nations. At one period the possession of a science becomes a want, its problems force themselves on the mind, and are importunate in their demands for a solution. At other times and under other circumstances the interest may be unfelt, and it may be almost impossible even to conceive the problem. This may be seen in the history of Theology, Philosophy, Political Science, Political Economy. In times unpropitious to a given study, a great and perhaps insoluble difficulty will be to determine what end it proposes, and what is its proper province. In more propitious times its questions will present themselves unbidden, and its old doctrines, if forgotten, will be rediscovered. This has been exemplified in the history of Logic. Its problem, the Conditions of Science, can only be a matter of curiosity to a scientific age: that is, either an age that actually

possesses many sciences; or an age that is strongly possessed by the Idea, and feels a restless aspiration to reduce it to a reality.

The Logical problem at a certain period forced itself on the Greeks: it was attempted by Parmenides and others, and received a provisional solution at the hands of Plato and Aristotle. Some time had to elapse before the inadequacy of this solution could be felt: for a time the interest ceased; the idea was no longer a portion of the world's thought: if the old treatises existed, the life that once animated them was extinct; and from various causes men did not begin to demand a revision of the old solution till about the time of Bacon. Educated Europe then felt the same want that had been felt by Aristotle and Parmenides; and the New Organon was produced by the same idea, by the same desire, that had before produced the Old. The men of one age, however, are not all moulded by the same influences, and there are numerous writers since this time whose treatises have not much beside their name in common with the works of Aristotle or Bacon. Not that there is any want of writers, who, with Bacon, felt the necessity of determining the Method of scientific inquiry; or who, living later, when so many sciences had been actually constructed, and thereby so many new and glorious phænomena introduced into the world, were desirous to study the laws of these phænomena, and to trace the processes by which they had arisen.

That the reader may understand the nature of the following work, an account should be premised of the scope and drift of the general inquiry of which it forms a part. What this is has already been briefly intimated; but that the reader may become more familiarized with the conception, it may be expedient not to dismiss the question at once; and as Aristotle's works are incomplete and contain no such plan or definition, we may take a rapid survey of some of the independent writers on the same subject in modern times, whose view of the problem is essentially the same, however they may differ in its treatment. Hereby we shall gain the authority of their names for the view we take, and, by noticing any questions which some of them may have handled and others neglected, may have an opportunity of bringing out into relief the main branches into which the inquiry is subdivided.

§ 2. In the Introduction to his System of Logic, Mr. Mill

announces that he is going to expound the Science of Evidence; and points out the limits that divide it from Metaphysics. Logic, according to his view, is not the science of Belief, but of Belief so far as it professes to be founded upon Proof. To determine what facts are ultimate, and what are resolvable into others, what are the propositions for the establishment of which Evidence is not required, is the office not of Logic, but of the sister science of Metaphysics. His definition is unobjectionable; but his limitation, which is adopted to avoid certain matters of controversy, appears to be erroneous. Relatives and Opposites, if we may be allowed to assume an Aristotelian maxim, fall under the same science: the scientific explanation of one Relative or Opposite is at the same time an explanation of its correlative. Now derivative truths and underived truths, concluded and unconcluded, primary and secondary, are both Opposites and Correlatives, the one being the evidence and ultimate ground of the other. Logic then, if we admit the soundness of this principle, as it treats of the former, must also treat of the latter; as it treats of the nature of conclusions, must also treat of the nature of original premisses. Again, it is a reasonable maxim [1] that the same theory should treat of the whole of a class. If then Logic examines Science, it must not separate it into two parts, examine the one and neglect the other, examine the superstructure, and neglect the basis or foundation. In other words, the same science which treats of one Criterion or truth-organ, must treat of all the Criteria or truth-organs: that which investigates the faculty of Inferences must also investigate the faculty of Intuitions: that which examines the instrument of Mediate must examine the instrument of Immediate truth-apprehension. Or, to use Mr. Mill's own term, the science of Evidence must not content itself with examining the nature of derivative or borrowed evidence, but must also ascertain the conditions of underived or unborrowed evidence.

Mr. Mill allows that Logic and Metaphysics, according to his conception of them, will form the two halves of one whole body of truth; but his practice shows a closer connexion between them than he allows in theory. His own treatise is an instance of the

[1] Post. Anal. I. 28.

impossibility of going far into the conditions of Inference without entering into the question of truths unsusceptible of inference: for though he seems to have intended to avoid the topic, and indeed announces that his theory will be such as the disciples of Hartley and Reid, of Locke and Kant, can equally accept; yet the topic is broached, and he himself clearly appears as an adherent of what is called the Sensational school.

In Mr. Whewell's Philosophy of the Inductive Sciences the nature of Logic is described with great precision. It is a complete insight into the essence and conditions of all real knowledge, and an exposition of the best methods for the discovery of new truths. Its province is to determine the difference between true knowledge and its precarious or illusory semblances, and the conditions under which it is obtained. Still shorter, it is the theory which explains the nature of knowledge, and the process of discovery. These definitions are not so general as that given by Mr. Mill, which proposes for discussion all evidence whether scientific or unscientific; nor do they profess to apply to more than one branch of Logic. Another branch investigates the conditions of legitimate and illegitimate Opinion. [1] Yet, as the highest element of an object chiefly constitutes its essence, and should be given in its definition, and the investigation of Science is of higher rank and value than the investigation of Opinion, the above formulæ would not be inadmissible as definitions of the whole genus, Logic.

The discrimination between Scientific and Unscientific method has ever been the leading aim and inspiration of the genuine logician. We have traces of this antithesis in the fragments of Parmenides where he compares Reason and Opinion; in the Platonic contrast of Dialectical and Rhetorical reasoning; and Aristotle's distinctions between Science and Dialectics. The writers hardly deserve the name of logicians who confine themselves to examining the conditions of all reasoning, that is, the laws which are common both to Scientific and Unscientific or Dialectical method, without going on to the inquiry to which this is merely

[1] Ἑκάστου γὰρ τὸ βέλτιστον ἐν τῇ οὐσίᾳ μάλιστα, ... ὥστε τοῦτο καὶ τὸν ὁρισμὸν ἔδει μᾶλλον σημαίνειν. —Topics vi. 12.

Ῥητέον οὖν ἢ τὸ βέλτιστον ἢ τὸ ἔσχατον.—Topics vi. 8.

preparatory, what are the peculiarities which constitute the superiority of the former.

This inquiry is the end proposed by the author of the Novum Organum. We have here indeed but the undeveloped germ, the rudimentary idea of the new method: but it is the idea, the germ, in its full vigour and power, safe to strike deep root in all minds fitted to receive it, and realize its mighty destiny. It may be doubted whether the spirit of the method may not even now be better caught from the original work of Bacon, rough and inarticulate as it is, than from the more finished treatises that have appeared after the instrument had been perfected and polished by practice. This work is an instance how much less a degree of precision is required for practical purposes than is demanded in speculation. It cannot be disputed, that, by acting on men like Newton, Bacon was to a certain degree the creator of the modern sciences. Yet how little is there in his works but the reiterated doctrine, a thousand ways illustrated and enforced, that if any thing like science was to be obtained, the preliminary observations must be more exact, and more numerous! That which chiefly displays the greatness of Bacon's mind, and most impresses the reader with admiration, is the strong faith he places in the powers of the new method, and the almost prophetic insight with which he hails the regeneration of the sciences that would ensue. And yet there were plausible objections to be urged against its success. There is printed among his works an instructive letter from a certain Thomas Bodley; which might afford consolation to any one who finds scepticism where he looks for encouragement. Bodley, though in a friendly manner, attempts, and that with great plausibility, to throw cold water on Bacon's hopes; giving him credit for ingenuity, &c., but quoting old proverbs to the effect that there is nothing new under the sun, and insinuating that there was nothing new in his method; that, if different, at most it was but different in degree: that philosophic creeds were destined to revolve, and that he was now merely reviving what had long ago been exploded: that before Bacon many ardent enthusiasts had arisen, who had hoped by more perfect methods to increase the store of human knowledge, whose attempts had proved abortive, &c. &c. This was from a person whose judgment he respected. But he felt that the difference of

degree was a difference of kind, and continued to urge the world to adopt the new plan, and time has verified his anticipations.

The Critic of Pure Reason, or Transcendental Logic, of Kant interests us so far as it is engaged with the same problem of exhibiting the structure of science: so far as it calls in question our knowledge of a spiritual world, it is beside our purpose. He divides the truths that compose the body of science into two classes: material truths that are derived from experience; and those of a formative and organizing character, that are furnished *a priori* by the mind. The object of the Critic is to specify the latter, and the progress of the discussion discloses his views of the constitution of philosophy. He divides formal principles into four classes, as contributed by Sense, Understanding, Judgment, and Reason. The pure or *a priori* Sense supplies the perception of Space and Time, creating the mathematical sciences, whose laws penetrate the future structure of truth in all directions.

The Understanding furnishes certain generic conceptions and axioms, under which experiences must fall, and by which they must be governed.

The Judgment, in what he calls its Reflective office, gives the precept of Generalization, or the command to look for Unity in Plurality, with the expectation of ultimately completing the process. In its Determining faculty it issues the precept of Specification, or the command to look for Plurality in Unity, whether in dividing and particularizing the above-named axioms and conceptions of the Understanding, or in subdividing the orders and laws discovered by Induction.

The Speculative Reason furnishes certain supreme Ideas, necessary to complete the systematizing process, and to cement the whole of thought together in absolute unity.

Practical Reason, besides supplying to Speculation its supreme Idea, creates itself the whole science of Morality.

Thus we have the outline and framework of the whole of philosophy, and of one portion of it something more. The remainder, the materials to fill up this outline, to fit into this framework, must be supplied by Sense and Induction. We see, then, that the purpose of Kant, as well as of the above-mentioned writers, was to exhibit the outlines and lineaments of Philosophy. We might quote others who have been engaged on the same

subject, but that we have already quoted enough. As these writers have been adduced to throw light on the views of Aristotle, we may further compare them on certain points suggested by his writings.

We shall find that one problem of his Logic is the determination of the formative truths or Axioms; or principles independent of Experience, and common to all the sciences. (A.)

Another problem is the nature of the Theses, or principles characteristic of their appropriate science; their relation to the conclusions; and the shape and constitution of the whole body of truth in which they are incorporated. (B.)

A third problem is the method of Induction, or the process by which principles are discovered. (C.)

Kant's Critic of Pure Reason discusses A, which is indeed its great object; throws light incidentally on B; and omits C, which is foreign to his plan.

It did not belong to Bacon to recognize A; he will not anticipate a very definite solution of B; and is chiefly employed on C.

Mr. Whewell treats of B and C, and apparently of A; but it is not clear where he draws the line between *a priori* and *a posteriori* conceptions: his Axioms are not similar to those of Aristotle, and contain what is characteristic of particular sciences.

Mr. Mill investigates B and C, but does not recognize A; although he seems unsuccessful in explaining the principle of Uniformity by Experience, and his account of the Canons of Induction assumes the principle of Causation.

By this time it may be hoped that we have a tolerably clear conception of a certain subject matter which many writers have considered worthy of scientific investigation. To give however such a definition of Logic as shall clearly show the limits that part it from Metaphysics, is by no means easy. If, for instance, Logic is the science of Knowledge, there are some questions about Knowledge which Logic does not consider. The relation of Subject and Object, of the Mind and the World, of our conceptions of the world, and that which the world is in itself independently of our conceptions, are questions which must be assigned to Metaphysics. These may be excluded, by ascribing to Logic the theory of the internal, not the external relations of Knowledge. What is the final shape and organization of human

Belief, what the relation of affiliation or interdependency between two portions of thought, whatever may be their relation to outward existences, will then constitute the problems of Logic.

§ 3. We may next give a rapid sketch of the contents of the Organon, in order to render more intelligible that portion of it which is here translated. If we assume that Logic has to determine what is the perfection of the intellectual faculties, and what are the measures to be taken for this end, it will inquire what is the nature of Science, and how it is to be pursued; and what is Opinion, for this is often the utmost we can obtain, and how securable, as far as may be, from error. The formation of Science and of Opinion, by which we mean any unscientific belief, is partly similar, partly dissimilar. Logic, then, will naturally fall into three divisions:—

(A.) The generic branch, which treats of reasoning in general, whether the result is Opinion or Science.

(B.) The specific branch, which treats of reasoning the result of which is Science, Inductive or Deductive.

(C.) The specific branch, which treats of Dialectical reasoning, the result of which is Opinion.

(A.) This branch is contained in the Prior Analytics, to which we may append the Hermenia and Categories. The first of these treats of Syllogism, the second of Propositions, the third of Terms. Their contents are well known, having been transfused into the works of the scholastic logicians, whose only fault was that they did not sufficiently perceive that these were merely preliminary inquiries. The principle involved in all Syllogism is the *dictum de omni et nullo*,[1] which it will appear is identical with the Axiom, or the principle of Contradiction. When Dugald Stewart observes that the whole of the science of Syllogism is comprised or implied in the terms of one single Axiom, his assertion is quite correct; the doctrine of Syllogism merely determining, on the authority of the Axiom itself, under what conditions the Axiom is applicable.

His assertion, however, (Philosophy of the Human Mind, part 2, chapter 3,) that the object of Aristotle is to demonstrate by abstract reasoning the conclusiveness of demonstration, to

[1] See Appendix, (A.)

demonstrate by the syllogistic theory the validity of the syllogistic theory, is totally unfounded. No doctrine is enforced with more emphasis by Aristotle than this, that some truths are indemonstrable: and the very proposition he instances as being plainly indemonstrable, both as possessing already the highest possible evidence, and as required for the demonstration of other truths, is the Axiom or principle of Syllogism.[1] To show the limits of its application, he employs the principle itself, because it is supreme, and there was no higher authority to which he could appeal.

The laws of Modality are investigated in an inquiry that is preliminary to the theory of Science, as a certain modality of premisses and conclusions is an essential characteristic of science. Modality is sometimes called Matter, and it is a common doctrine that matter is extralogical, and this would seem to exclude modality from the consideration of Logic. Now the expression, that matter is extralogical, may mean, that, though Logic examines Science, Astronomy for instance, yet it teaches nothing about the stars, the subject-matter of Astronomy. For every science has its own subject-matter or province with which no other science interferes. But though Logic teaches nothing about the matter of Astronomy, yet, as a science, Logic has its own subject-matter, to which Astronomy is equally a stranger. So the matter of Chemistry is extralogical, and the matter of Logic is extrachemical. However, it is too evident a fallacy to infer, that because the matter (of other sciences) is extralogical, therefore Modality, sometimes called Matter, is extralogical. But it may perhaps be urged, that none but the professor of a particular science can know the modality of a particular proposition; and therefore it cannot be treated of by Logic. But Logic is equally ignorant of the quantity and quality of the proposition arising from the connection of two terms, and yet it investigates the laws of quantity and quality: it will therefore investigate Modality as it does quantity and quality, that is, hypothetically.

If the words Matter and Form are used in the Kantian sense, then it must be remembered that the notions of necessity and

[1] See Appendix, (A.)

contingency compose, according to Kant, part of the formal furniture of the mind, and in this view Modality would fall under the province of Logic.

Another subject discussed in the Prior Analytics is the fact, that false premisses may give a true conclusion, i. e. that an hypothesis is not sufficiently established by showing that its consequences agree with phænomena: and the mode in which premisses and conclusions may reciprocate: inquiries which seem to be a preparation for explaining the nature of Analytical and Synthetical reasoning,[1] and the method of testing Hypotheses. Also a slight and inadequate account of Induction is given. In general it must be confessed of these treatises, that the investigations are carried out with a minuteness that may be curious, but is not otherwise either interesting or valuable.

§ 4. Having concluded the generic theory of Syllogism, we proceed to its specific peculiarities.

B. We treat at first of Deductive Science: and this division leads us naturally to inquire, to which class does Logic itself belong, Deductive or Inductive? Aristotle treats it deductively, for he begins[2] by defining Science to be the reference of the laws of phænomena to their causes. We must not suppose however that he was entitled to assume a definition, as in the simplest mathematical sciences, without any justificatory inquiry. Logic, like Politics, is a practical science; its reasoning is Analytical, and the basis of its reasoning the conception of an end to be attained. As the end of Politics is happiness, or something similar, and its problem the measures and machinery by which it may be promoted; so the end of Logic is science, and its problem the process of discovery: and the justification of the principle it assumes, that is, of the end it proposes, would appear to consist in the proof of two propositions: these propositions are: that no higher end is practicable, and that there is no insurmountable obstacle to the attainment of the end proposed. When these are proved, we may assume that the end is rightly selected, and that the theory rests on its appropriate basis.

[1] For an explanation of these processes see Dugald Stewart's Philosophy of the Human Mind, part ii. chap. 4.

[2] Post. Anal. i. 2.

Now with regard to the former point, there are none who maintain that the aim selected is not sufficiently high: for the dissentient school contends that it is only too ambitious, insisting that science must renounce the hope of discovering Causes, and content itself with a humbler aim, the knowledge of Laws. The legitimacy of the hypothesis then depends on the other point, the truth of the suppositions analytically involved, or the feasibility of the steps demanded: what these are we shall presently examine.

Meantime it must be observed, that the main characteristic of Aristotle's Logic, which is both the foundation of the rest of his own theory, and brings him into contrast with a modern school, is his attributing to science the investigation of Causes. Many writers—for instance, Hobbes, Berkeley, Hume, Brown, Dugald Stewart, Comte—deny the existence of any thing like causation, maintaining that what is so called is merely the invariable, but, for all we know, arbitrary, conjunction of antecedent and consequent. The maintainers of this theory confess that the belief in natural causation is an universal instinct, which has been the great impulse to scientific research. They seem to have forgotten the mathematical sciences; for no one could maintain that the attributes of figure and number—for instance, that the interior angles of a triangle are equal to two right angles, or that three is the cube root of twenty-seven—are merely arbitrary and fatal; and it has not been shown why physical cause and effect are not as naturally connected as mathematical subjects and attributes.[1]

To abandon the notion of Causation is to abandon the notion of Necessity as a characteristic of knowledge: for however constant and fatal the conjunction of two terms may be, yet if we only perceive them in juxtaposition, unless we perceive the manner in which they are locked and linked together by their essences, we cannot recognize the necessity of their connection.

If however we introduce the notion of Causation and intelligible Necessity,[2] we are inevitably led to rest science on definitions: for in order to perceive the essential interpenetration of

[1] See Whewell, Philosophy of the Inductive Sciences, book iii., also book xi. 16.

[2] Post. Anal. book i. 4, 6.

any two terms, we must have a distinct conception of their essence, and the expression of such a conception is Definition.

From this consideration some characteristics of scientific propositions might be deduced, which will be found to distinguish them from dialectical propositions. The terms of a scientific proposition, being essentially connected, will be coextensive or commensurate.[1] Again, if the diversity of sciences depends on the diversity of the genus investigated, and Nature is heterogeneous, there will be a multiplicity of sciences;[2] and as the same predicate cannot be homogeneous to two heterogeneous subjects, the same predicate will not enter two different sciences, but every scientific proposition will be confined to its one appropriate science. Whilst these are necessary, essential, coextensive, appropriate; dialectical predicates and propositions are contingent, accidental, incommensurate, and promiscuous or indeterminate.

If the conclusions of science must satisfy these conditions, it is not difficult to see what must be the nature of its foundations.

(1.) Definitions will be required, both of subject and of attribute, both of the compound and of the elementary. [3]The definition of the elementary will not be further analyzable; the definition of the compound and dependent must contain its elements and antecedents: and thus its parts will correspond to the premisses and conclusions of a syllogism.

(2.) But we need more than Definitions: if we have merely these, our conclusion will be merely hypothetical. To give it a categorical character, we must be able to assert the real existence of the subject in which the attribute inheres, or of the primary power or elementary substance which generates the remote consequence. The proposition containing this assertion is called the Hypothesis.

(3.) If we are not sensible of wanting more than these, still there is another principle which we always tacitly assume. In passing from any premisses to a conclusion, we rest upon the Axiom, or the principle of syllogism. The intuition of this principle constitutes the reasoning faculty. It is not always

[1] Post. Anal. book i. 4, 5. [2] Post. Anal. book i. 7, 9, 27, 32.
[3] Post. Anal. ii. 8.

used in its widest extent, in which it is a predication of identity: in mathematics it is merely regarded as a predication of equality. The Topics of Dialectics and Rhetoric are mostly particular cases of the Axiom.

These elements of knowledge, which form the basis of Deductive science, will form the conclusions of Inductive inquiry: [1]for in general the problems of all sciences may be divided into four classes:—

(1.) Is it a fact, that a given subject possesses a given attribute?

(2.) What is the reason of the fact, that a given subject possesses a given attribute?

(3.) Is a given conception of an elementary substance or power imaginary, or real?

(4.) What is the character of a certain primary substance or power?

Of these the third and fourth are Hypothesis and Definition, the result of Inductive inquiry, and the basis of Deduction. The second problem should be answered by Demonstration, and its answer will contain the solution of the first.

We may now consider the question suggested above, what suppositions are involved analytically in the hypothesis, in the possibility of science such as we defined. They are two: the one may be called an ontological, the other a psychological postulate. As science [2] professes to explain causes and answer every Why?, the series of genera and differentiæ that enter into the composition of an object must be finite, for the cause of a generic property is to be found in the definition of the genus; and there would be no exhausting the series of possible questions, why a subject possesses a given generic property, unless the number of genera and differentiæ contained in the subject is finite. And as the series composing the formal cause of a subject must come to an end, in order that we may reach the formal element that is immediately connected with the predicate; so must the series of material, efficient, and final causation come to an end, in order that we may exhaust the questions Why?, when the immediate antecedent happens to be a term in the

[1] Post. Anal. ii. 1. [1] Post. Anal. i. 19, 20, 21, 22.

material, efficient, or final series. On these suppositions depends the possibility of realizing the scientific idea. Unless we have first Causes, and unless the series of Generalization is finite, we have no basis of Demonstration. Both of these suppositions —that the chain of antecedent causes to any consequent, and the number of specific elements in any essence, are finite—are expressed by Aristotle in the assumption, that every object is definable, for the definition includes every kind of cause; and this may be called an Ontological hypothesis.

This supposition however that there are indemonstrable truths is not alone sufficient to show the possibility of Demonstration: we must further assume that we have some faculty or faculties corresponding to these truths, and capable of apprehending them: Aristotle asserts[1] that Sense and Reason are such faculties: and this may be called a Psychological hypothesis. These two hypotheses, then, are indispensable to the theory of science. Let us first consider the Psychological hypothesis.

Upon this subject bear the controversies about the Criterion or Organ of truth. Philosophers were divided into those who denied and those who maintained the existence of a Criterion: the former were the Sceptics. Those who maintained a Criterion either advocated a simple or a mixed Criterion: the advocates of the former were divided into Sensationalists and Rationalists, as they advocated Sense or Reason; the advocates of the latter accepted both Sense and Reason. Democritus and Leucippus were Sensationalists: Parmenides and the Pythagoreans were Rationalists: Plato and Aristotle belonged to the mixed school. Among those who advocated Reason as a Criterion there was an important difference: some advocating the common Reason, as Heraclitus and Anaxagoras: others the scientific Reason, or the Reason as cultivated and developed by education, as Parmenides, the Pythagoreans, Plato and Aristotle. In the Republic,[2] Plato prescribes a training calculated to prepare the Reason for the perception of higher truths. Aristotle requires education for the Moral Reason. The older Greeks used

[1] Post. Anal. i. 3, and ii. 15.

[2] Ἐ'ν τούτοις τοῖς μαθήμασιν ἑκάστοις ὄργανόν τι ψυχῆς ἐκκαθαίρεταί τε καὶ ἀναζωπυρεῖται.—De Republica, vii. § 9.

the word Measure instead of Criterion: and Protagoras had said that Man was the Measure of all truth. This Aristotle interprets to mean that Sense and Reason are the organs of truth;[1] and he accepts the doctrine, if limited to these faculties in a healthy and perfect condition. These names then cannot properly be ranked among the Common Sense philosophers, where they are placed by Sir William Hamilton.

The manner in which the Will is the Criterion of moral truth may be left to the theory of Morality. It is where the faculty has to be trained before it is capable of perception, as in the fine arts and morals, that the theory of the Criterion is most difficult, and it is here that the Sceptics find it most advantageous to maintain the controversy. There is nothing on the subject in the Organon.

When Reason is said to be an Organ of truth, we must include, besides the intuitive, the syllogistic faculty. This is the instrument of the mediate or indirect apprehension of truth, as the other of immediate. The examination of these instruments, in order to discover their capabilities and right use, is Logic. This appears to be the reason why Aristotle gave the title of Organon to his Logic. So Epicurus called his the Canon or Criterion. The controversy on the Criterion is to be found at length in Sextus Empiricus De Criterio.

What we have denominated the Ontological hypothesis of Deductive Logic, the finiteness of generalization, appears to be the same as the hypothesis demanded by General Logic, the existence of universals, and the hypothesis of Inductive Logic, the uniformity of nature. General Logic demands the existence of universals[2]: for though it would be possible to reason, as Aristotle observes, without the Platonic Ideas, it would not without universals; for without these there could be no middle term (which is always universal), and without a middle term no syllogism. Inductive Logic also makes a similar hypothesis, under the name of the Inductive principle, the belief that Nature is a "tissue of laws," or that she is "stable and uniform." These hypotheses, which are necessary for Syllogism and Induction, do not appear essentially distinct from the hypothesis

[1] Metaph. x. 2, and xi. 6.

[2] Post. Anal. i. 11.

which is necessary for Demonstration. For the same tendency that made us reduce the number of particulars by ranging them under universals would impel us to reduce those universals by ranging them under others still higher; and the simplifying process, which began by reducing the Infinite to the Many, would not desist till it had reduced the Many to the One.

Besides the existence of universals, Deductive Logic makes the hypothesis that every event has a cause, and that the chain of causation is finite. As, however, the reduction of universals to the one appeared the work of the same principle that reduced the infinite to universals, and was not the matter of a distinct postulate, so the principle of looking for an absolute primary may be considered the same as that of looking for an antecedent, and does not require a separate hypothesis.

The principle of the finiteness of the chains of generalization and causation belongs to the science of Being. In the Organon the argument is led so far, and then dropped. The principle is asserted and briefly considered in the Metaphysics.[1]

These hypotheses of Deductive Logic—the necessity of assuming an absolute termination to the generalizing series, and an absolute beginning to the chain of antecedent and consequent, if science is to be possible—are recognized by Kant, and ascribed to the Reflective Judgment and Reason. The fact that laws can thus be given to Nature by the mind, he calls its autonomy or legislative power. He connects the law of Generalization and Specification with the teleological principle, by which we introduce final causes into natural science. As the organization of objects is determined by their end or destiny, so, if the end of Nature is to be known, she will obey any laws which are the conditions of being known: and as the condition of her comprehensibility is the finiteness of the above-mentioned processes, it follows that these processes are finite.

§ 5. The Inductive method shall be considered after we have discussed the nature of Dialectics.

(C.) Dialectics is defined[2] to be the method of arguing with

[1] Metaph. ii. 2.

[2] Μέθοδος ἀφ' ἧς δυνησόμεθα συλλογίζεσθαι περὶ παντὸς τοῦ προτεθέντος προβλήματος ἐξ ἐνδόξων, καὶ αὐτοὶ λόγον ὑπέχοντες μηθὲν ἐροῦμεν ὑπεναντίον.—Topics, i. 1. A similar definition is given Soph. Elench. 34, where it is called a

probability on any given problem, and of defending a tenet without inconsistency.

We cannot always, for instance in the practical affairs of life, argue with scientific rigour, and even the scientific method by which we discover principles must differ from that by which we develope their consequences. Besides then the doctrine of Demonstration and of Scientific Induction, we require a theory to unfold all the possible kinds of argumentation and less rigorous methods of fortifying an opinion.

The Aristotelian Dialectics must be distinguished from the Dialectics of Plato, who included under this name his Metaphysics or Philosophy, as well as the Aristotelian Dialectics. Now his Philosophy was a determinate science with a determinate province, whereas the latter is unscientific reasoning in any province whatsoever. It was very natural, however, to call them by the same name. Dialectics, as we shall see, or something like it, must always be employed by sciences that have to establish their first principles; for its great function is to examine hypotheses, and test their legitimacy by deduction of their consequences. In this respect it presents an antithesis to the Mathematical sciences, which rest on given principles, and have only to unfold them: and this is the function that, in speaking of Dialectics, Plato generally has in his eye. Philosophy presents the same contrast to the Deductive sciences; for at its outset it has no definite principles, and to fix them must employ a Dialectical method. There is a greater air of liberty and independence about both Dialectics and Philosophy: the sciences have their task imposed them: certain principles are rigorously prescribed from which they must not depart: whereas the office of Dialectics and Philosophy is the determination of principles; and every thing is subject to their criticism. Both too have an air of universality: for Philosophy, considering the supreme sources of the systematic unity of nature, contemplates to a certain degree the provinces of all the sciences: and Dialectics is not, like science, divided into branches, but is opinionative argumentation in all

Faculty; in another place it is called an Art, ὁ τέχνῃ συλλογιστικῇ πειραστικὸς διαλεκτικός.—Soph. Elench. 11.

provinces indiscriminately; a fact, Aristotle observes,[1] that accounts for their confusion. Besides using Dialectics as a name for Philosophy, Plato as well as Aristotle applied it to any reasoning not founded on scientific principles.

As the ancients confounded it with Metaphysics, so in modern times it has been confounded with Logic. The popular notion of the latter, prevalent among the lay public, though not perhaps among professed logicians, exactly corresponds to the nature of Dialectics. It therefore may be worth while to point out their relation. Dialectics, like Science, is not Logic, but the subject-matter of Logic. Logic considers Astronomy, but is not Astronomy, and similarly she contemplates Dialectics, but is not Dialectics. The stars are the subject-matter of Astronomy, and the animal kingdom of Zoology: but the stars are not Astronomy, nor are animals Zoology. So Dialectics is a subject-matter of Logic; is handled, anatomized, and its conditions determined by Logic; but for all that it is not Logic, any more than the animal kingdom is Zoology, or the vegetable kingdom is Botany. If Dialectics is Logic, then Ethics is Logic, and Chemistry is Logic; for there is the same relation between Logic and Dialectics that there is between Logic and Science.

It must be observed, however, that as Science is chiefly characterized, by its peculiar propositions or Theses, while the common principles are unimportant; so Dialectics is characterized by its common or topical propositions, all of which may apply to any one subject, and any one of which may apply to all subjects; (for which reason there is but one Dialectics, while there are many sciences:) from which it follows, that the Logic of Dialectics, which enumerates these topics, will go further to constitute the dialectician, than the Logic of Science, which cannot enumerate the Theses, to confer the possession of a particular science. [2] In this

[1] *τὸ αὐτὸ ὑποδύονται σχῆμα τῷ φιλοσόφῳ· περὶ μὲν γὰρ τὸ αὐτὸ γένος στρέφεται ἡ διαλεκτικὴ τῇ φιλοσοφίᾳ· ἔστι δὲ ἡ διαλεκτικὴ πειραστικὴ περὶ ὧν ἡ φιλοσοφία γνωριστική.*—Metaph. iv. 2.

[2] This may explain the passage in the Rhetoric, *περὶ συλλογισμοῦ ὁμοίως ἅπαντος τῆς διαλεκτικῆς ἐστὶν ἰδεῖν, ἢ αὐτῆς ὅλης ἢ μέσους τινός.*—Rhet. i. 1. Here Dialectics itself is said to theorize (*ἰδεῖν*), and General Logic seems to be called a part of Dialectics. This latter statement must be inaccurate: for General Logic is a preliminary to the theory

light the theory of Dialectics may be considered to be an integral part of Dialectics: and thus it happens that, though Dialectics and Logic are related as Logic and Science, yet there is a closer connection between the former than between the latter.

At the risk of creating confusion, we must notice that the word Logic, as applied to the Science of Evidence, and as we have hitherto used it, is modern. Aristotle's term for this theory is Analytical Science.[1] When he uses the word Logical, he uses it as equivalent to Dialectical; and he generally uses it when he wishes to oppose the Dialectical to the Scientific. It, or some cognate, will occur in several of the passages we shall proceed to quote, but to avoid confusion we shall always translate it by the word Dialectical.

(1.) An argument is Dialectical that rests on Inappropriate principles, that pursues an Inappropriate method.

As in Physical science the Appropriate method is Inductive, Dialectical is often opposed to Inductive.

Democritus reasoned inductively, and is instanced as using a Physical and Appropriate, not a Dialectical, method. Others were great dialecticians but no observers, and therefore unsuccessful in their physical theories. Great familiarity with phænomena is necessary for the Physical philosopher.[2]

The forced and strained theories of philosophers are due to their perverse method. They make every thing bend to certain assumed dogmas, instead of being guided by observation.[3]

The more abstract a Dialectical proof is, the wider it departs from the Appropriate principles.[4]

of Science, just as much as to the theory of Dialectics: but it is possible that Dialectics is here not used in its proper sense, but as a synonym for Analytics or Logic.

[1] Rhet. i. 4; Anal. Post. i. 22.

[2] ἴδοι δ' ἄν τις καὶ ἐκ τούτων ὅσον διαφέρουσιν οἱ φυσικῶς καὶ λογικῶς σκοποῦντες . . . . . Δημόκριτος δ' ἂν φανείη οἰκείοις καὶ φυσικοῖς λόγοις πεπεῖσθαι. Neglect of Observation is called ἀπειρία. — De Gen. et Corr. i. 2.

[3] τούτου δ' αἴτιον τὸ μὴ καλῶς λαβεῖν τὰς πρώτας ἀρχάς, ἀλλὰ πάντα βούλεσθαι πρός τινας δόξας ὡρισμένας ἀνάγειν· δεῖ γὰρ ἴσως τῶν μὲν αἰσθητῶν αἰσθητάς, τῶν δὲ ἀϊδίων ἀϊδίους, τῶν δὲ φθαρτῶν φθαρτὰς εἶναι τὰς ἀρχάς, ὅλως δ' ὁμογενεῖς τοῖς ὑποκειμένοις. — De Cœlo, iii. 7.

[4] Ἀπόδειξις λογικὴ . . . ὅσῳ καθόλου μᾶλλον πορρωτέρω τῶν οἰκείων ἀρχῶν.—De Gen. Anim. ii. 8.

The theory of the Platonists arose from their Dialectical method, for they were the first great dialecticians.[1]

Dialectical method is, however, not always opposed to Induction: it is applied to unscientific argument when the appropriate principles are Deductive. There are two [2] examples of this in the following treatise.

So far as a Dialectician or Rhetorician employs the appropriate principles or appropriate method, he ceases to be a Dialectician, and his argument becomes scientific.[3]

(2.) Another mode of expressing the peculiarity of Dialectics as opposed to Science we have in the Rhetoric; that it has no peculiar or appropriate subject genus.[4] Its arguments will apply to heterogeneous subjects:[5] whereas no scientific proof can migrate from its original science:[6] for every science has a determinate province, and, while there is but one Dialectics, there are as many sciences as there are provinces. This property of Dialectics is equivalent to the former, that it disregards the Appropriate method.

(3.) Or we may characterize Dialectics by saying that its treatment of any particular matter will be accidental,[7] whereas scientific propositions are all essential to their subject-matter.[8] This follows from the preceding: for any argument or medium

[1] ἡ τῶν εἰδῶν εἰσαγωγὴ διὰ τὴν ἐν τοῖς λόγοις ἐγένετο σκέψιν· οἱ γὰρ πρότεροι Διαλεκτικῆς οὐ μετεῖχον.—Metaph. i. 6.

[2] Anal. Post. i. 22, and 32.

[3] ἂν γὰρ ἐντύχῃ ἀρχαῖς οὐκέτι Διαλεκτικὴ οὐδὲ Ῥητορικὴ ἀλλ' ἐκείνη ἔσται ἧς ἔχει τὰς ἀρχάς.—Rhet. i. 2.

λήσεται τὴν φύσιν αὐτῶν ἀφανίσας τῷ μεταβαίνειν ἐπισκευάζων εἰς ἐπιστήμας ὑποκειμένων τινῶν πραγμάτων ἀλλὰ μὴ μόνον λόγων.—Rhet. i. 4.

καὶ μᾶλλον ἀπτόμενοι κατὰ τρόπον (κατὰ τὴν οἰκείαν μέθοδον (?)) μεταβαίνουσιν ἐξ αὐτῶν.—Rhet. i. 2.

[4] οὐκ ἔστιν ἑνός τινος γένους ἀφωρισμένου.—Rhet. i. 1.

οὐ περί τι γένος ἴδιον ἀφωρισμένον.—Rhet. i. 2.

περὶ τοῦ δοθέντος.—Ibid.

οὐ ποιήσει περὶ οὐδὲν γένος ἔμφρονα.—Rhet. i. 4.

περὶ πάντων.—Soph. El. 11. περὶ πᾶν γένος.—Ibid.

[5] διὸ καὶ ἐπ' ἄλλων ἐφαρμόττουσιν οἱ λόγοι οὐ συγγενῶν.—Post. An. i. 9.

πρὸς πολλοὺς ἔστι μετενεγκεῖν.—Soph. El. 11.

[6] οὐκ ἔστιν ἐξ ἄλλου γένους μεταβάντα δεῖξαι.—Post. An. i. 7.

οὐκ ἔστι μετενεγκεῖν διὰ τὸ ἐκ τῶν ἰδίων εἶναι ἀρχῶν.—Soph. El. 11.

[7] κατὰ συμβεβηκός.

[8] καθ' αὐτό. κατ' οὐσίαν καὶ κατὰ τὸ εἶδος.—Post. An. i. 23.

of proof essential to a subject would be commensurate with the limits of the subject, and peculiar and appropriate to that determinate genus. An accidental proof may be good Dialectically, but if it claims to be Scientific, is Sophistical.[1]

These three propositions then express the nature of Dialectics, and they may all be considered as identical:—

(1.) That it employs an inappropriate or unscientific method.

(2.) That it has no determinate matter, but employs considerations equally applicable to heterogeneous subjects.

(3.) That its statements are not essential to the subject of discussion, but accidental.

The uses of a method thus characterized are said[2] to be three:—

(1.) As an intellectual exercise.

(2.) In the common intercourse of life: for if we would persuade men we must appeal to their own opinions and convictions.

(3.) As an organ of the inductive sciences, for the discovery of Principles. To this last use we shall recur hereafter.

Its features are most distinct in the form Pirastike, to which its terminology originally belongs; and which we will therefore consider.

Pirastike is the examination of the pretender to a science, with a view to ascertaining his real knowledge, by one who makes no similar pretensions.[3] We have celebrated examples of this in the encounters of Socrates with the Sophists. Some of these professed universal knowledge, and gave oracular answers on any subject to all inquirers. Socrates would extract a dogma from them, and after eliciting further explanatory or justificatory statements, would put all their assertions together, and show that they were self-contradictory, or led to some acknowledged error. It is said that he was as dangerous to the incompetent statesmen of his age, as to its false teachers.

[1] *ἐπίστασθαι τὸν σοφιστικὸν τρόπον τὸν κατὰ συμβεβηκός.*—Post. An. i. 2. *οὔπω οἶδεν εἰ μὴ τὸν σοφιστικὸν τρόπον.*—Post. An. i. 5.

[2] Topics, i. 2.

[3] *Διαλεκτική τις . . . ἡ θεωρεῖ οὐ τὸν εἰδότα ἀλλὰ τὸν ἀγνοοῦντα καὶ προσποιούμενον.*—Soph. El. 11.

ἣν ἂν ἔχοι καὶ μὴ εἰδώς τις.—Ibid.

διὸ πάντες καὶ οἱ ἰδιῶται τρόπον τινὰ χρῶνται τῇ Πειραστικῇ· πάντες γὰρ μέχρι τινὸς ἐγχειροῦσιν ἀνακρίνειν τοὺς ἐπαγγελλομένους.—Ibid.

If the examiner is himself ignorant of a science, by what premisses can he expose the false pretensions of another who professes to know the science?[1] The propositions he employs must be conclusions or dependent truths, which would be known to one who was master of the science,[2] but which also may be known to one who cannot deduce them from their appropriate principles,[3] without which knowledge is unscientific.

The process was finally subjected to strict rules, chiefly calculated to secure the division of labour, by confining one party to the defensive, the other to the offensive, to avoid confusion, and prevent the dispute from becoming interminable.

The Answerer, the person who maintained the defensive, began by enouncing some dogma or Thesis[4] which he was willing to defend. This Thesis must not be confounded with the scientific principle; though, as the first truths of a science were submitted to a Dialectical examination before they were recognized, the two meanings would often coincide.

It was the office of the Questioner to show that this Thesis led to obviously false consequences, or could not be defended without an inconsistency. For this purpose he had not the licence of the Orator, who may argue triumphantly from assumptions his adversary would never concede, and obtain invincible data from unscrupulous witnesses, but was confined to propositions allowed by his opponent, and extracted by questioning, which made the process a series of Questions and Answers. And the Question was to be such as could be answered by a simple affirmative or negative.[5] If obvious, the proposition ought to be conceded; if otherwise, the Questioner had to adduce examples and claim it inductively. [6] The Answerer was not

[1] δύναται συλλογίζεσθαι ψεῦδος δι' ἄγνοιαν τοῦ διδόντος τὸν λόγον . . . ὥστε ποιεῖ δῆλον εἰ ἀγνοεῖ.—Soph. El. 8.

[2] ἐκ τῶν δοκούντων τῷ ἀποκρινομένῳ καὶ ἀναγκαίων εἰδέναι τῷ προσποιουμένῳ ἔχειν τὴν ἐπιστήμην.—Soph. El. 2.

[3] δίδωσιν οὐκ ἐκ τῶν ἰδίων ἀλλ' ἐκ τῶν ἑπομένων, ὅσα τοιαῦτά ἐστιν ἃ εἰδότα μὲν οὐδὲν κωλύει μὴ εἰδέναι τὴν τέχνην, μὴ εἰδότα δὲ ἀνάγκη ἀγνοεῖν.—Soph. El. 11.

[4] Topics, i. 9.

[5] πρὸς ἥν ἐστιν ἀποκρίνεσθαι, ναί, ἢ οὔ.—Topics, viii. 2.

πρὸς ἣν ἡ ἀπόκρισις ἢ καταφήσαντι ἢ ἀποφήσαντι.—Ibid.

[6] διαλεκτικὴ γάρ ἐστι πρότασις πρὸς ἣν, οὕτως ἐπὶ πολλῶν ἔχουσαν, μὴ ἐστιν ἔνστασις.—Ibid.

justified in denying it unless he adduced an Enstasis, or at least an Antisyllogism. When the Questioner considered he had sufficient premisses, he arranged them so as to show that they contained an Elenchus,[1] or refutation of his adversary's position. An Elenchus was considered meritorious if all its premisses were highly probable, and also the thesis it destroyed:[2] or if its premisses and the thesis were all equally probable, for then there would be no clue to discovering the seat of the falsehood. A Sophistical Elenchus was skilful when it was difficult to see whether the flaw was in the sequence or in the premisses: or when there was no doubt as to this, but it was hard to say what was the flaw in the sequence, or where the falsehood in the premisses. When the Questioner had pointed his Elenchus, the Answerer had to repel it if he could. His part shall be discussed presently.

A Dialectical proposition is defined[3] to be a probable opinion, prevalent among the many or among the philosophers, and either universally held by the many or by the majority, or either universally held by philosophers or by the most illustrious.

When the propositions that enter into Dialectical reasoning are analyzed, they are found susceptible of the same division as Scientific principles; some are limited,[4] others universal in their application.[5] But while Science is chiefly characterized by the former, its Theses, the common principles or Axioms being scarcely perceptible, and only entering as canons of syllogism; Dialectics, on the contrary, is not so much constituted by its Organa,[6] or specific principles, as by its common propositions or Topics. Again, the Organa differ from the Theses of Science in that they are not primary or original propositions, but merely premisses of a specific character: for if they were properly principles they would be undialectical.[7]

The Topics correspond to the Scientific Axioms, and probably many of them could be obtained from these by deduction. Aristotle does not give them in the form of propositions, but

[1] *συλλογισμὸς ἀντιφάσεως.*—Soph. Elench. 9.

[2] Soph. El. 33.

[3] Topics, i. 1, and 10.

[4] *ἴδια.* [5] *κοινά.*

[6] Topics, i. 11.

[7] *ἂν γὰρ ἐντύχῃ 'Αρχαῖς οὐκέτι Διαλεκτικὴ ἔσται.*—Rhet. i. 2.

only specifies the category or general conception that each involves. Many of them could scarcely be reduced to propositions, but are merely hints or precepts to assist us in conducting the argumentation.

The Organa, or specific premisses, are of infinite variety, and cannot, like the topics, be enumerated by the theory. They should be arranged in the memory or common-place book in their logical order.[1] They should be divided into genera, the chief of which will be, Ethical, Physical, and Metaphysical.[2] Definitions should occupy the first place, and then should come the attributes: and the names of the philosophers who originated any paradoxes should be noted.

To illustrate the division of Dialectical propositions, we may compare it with the analogous division that takes place in Rhetoric.

The Dialectical Theses correspond to the Rhetorical Issues.[3] These latter are different in the three branches of Rhetoric, and in each branch are various, falling under the categories of Fact, Quality, and Quantity.

The division of Rhetorical premisses is similar to that in Dialectics and Science.

Corresponding to the Axioms of Science and the Topics of Dialectics are the Topics or Elements of Rhetoric. The name of Maxim, which the Schoolmen gave them, may be explained by Aristotle's definition of Element:[4] "Any thing of great usefulness and great simplicity."

The peculiar propositions of Rhetoric, that correspond to the Scientific Theses and the Dialectical Organa, are its Specific[5] propositions, whether of wider[6] or narrower[7] application, and its Singular[8] circumstances. These last occur in Rhetoric, which treats of particular cases, but not in Dialectics, which, being of a quasi-philosophical nature, is confined to universals.

[1] Topics, i. 12.

[2] Plato, Sophistes, § 37.

[3] *ἀμφισβητούμενα*.—Rhet. iii.

[4] *ὃ ἂν ἓν ὂν καὶ μικρὸν ἐπὶ πολλὰ ᾖ χρήσιμον*.—Metaph. v. 3.

[5] *εἴδη*. The word *γένος* is used of the Organa, Topics, i. 12, but it is also used in the Rhetoric: *περὶ ἕκαστον γένος τῶν λόγων εἰλημμέναι δόξαι καὶ προτάσεις*.—Rhet. ii. 18.

[6] *κοινά*.

[7] *ἴδια*.

[8] *τὰ ἐξ ὑπογυίου*.

As the Organa or Generic propositions of Dialectics were divided into three classes, Ethical, Physical, and Metaphysical; so the Specific propositions of Rhetoric are ranged under three chief heads, Honour, Justice, Expediency.

It may be observed, that Aristotle always uses the same or similar terms to express the collection of Scientific, Dialectical, and Rhetorical propositions.[1]

After the enumeration of the Topics, directions are given to the Questioner as to the order in which the questions should be arranged, and the manner in which they should be put.[2] As the Answerer will be disinclined to make any concessions, the bearing of which on the Thesis he perceives, it will be an object to conceal the drift of each particular proposition. This may be effected by mixing the essential propositions with others irrelevant, and by deranging the order of the essential propositions, that is, proposing them unconnectedly and incoherently, not in the sequence in which they will finally enter the syllogism. The concealment is completely successful when the Answerer does not suspect that he has lost his cause after the fatal concessions have been made, till his opponent extricates and rearranges them, and shows that they involve the contradictory of the Thesis. The character of the opponent should be studied: some from confidence in themselves and contempt of their adversary will make any concessions at first, but afterwards grow more cautious: from such the necessary propositions should be drawn before their fit of circumspection comes on. Others are excessively cautious at first, but afterwards grow ashamed of making so many difficulties, and become more liberal in their concessions. The jealousy of these persons, says Aristotle, should be exercised on indifferent matters, and the important propositions kept back till they begin to suspect themselves of over-timidity. Similar artifices are suggested, and some represented as fair, others as Sophistical.[3] One of these is, to rouse the anger of

[1] *ἐκλέγειν, ἐκλαμβάνειν.* — Anal. Post. ii. 13.

προτάσεις ἐκλαμβάνειν. — Anal. Prior. i. 27.

προτάσεις ἐκλέγειν.—Anal. Prior. i. 30.

προτάσεις ἐκλεκτέον.—Topics, i. 12.

ἔχειν ἐξειλεγμένα.—Rhet. ii. 22.

τρόπος τῆς ἐκλογῆς τοπικός (i. e. *εἰδικός*).—Ibid.

[2] Topics, viii. 1.

[3] Soph. El. 12 and 15.

your adversary by barefaced attempts at unfairness, as a disputant is not so formidable when he loses his temper! These nefarious practices are pointed out of course for our avoidance: besides, we have scarcely a right[1] to speak with reprobation of Sophistry, unless we understand its character. Some artifices, though unjustifiable against a fair adversary, are justifiable against one who is unscrupulous himself:[2] but however fair, as far as he is concerned, we must avoid them from respect for ourselves:[3] and, if we follow Aristotle's advice, instead of meeting Sophistry with Sophistry, we shall exercise a discrimination in choosing our adversary, and avoid engaging with those who cannot observe the laws of honourable warfare.[4]

We now proceed to the duty of the Answerer: for though the original province of Dialectics was merely the offensive process, that of assailing a given Thesis,[5] it soon proceeded to investigate the art of defence, and this province accordingly is included in its definition. The theory of Solution is contained in the short treatise on the Sophistical Elenchus, which ought to be regarded as the last book of the Topics.

We may first, however, determine what propositions the Answerer may be expected to concede, and what he may claim to withhold:[6] and the determination depends on the nature of the Thesis he advocates; which must be either probable, improbable, or indifferent, neither highly probable nor highly improbable. If the Thesis is improbable, its contradictory, the conclusion of the Elenchus, will be of itself probable; and as the premisses of a syllogism ought always to be more probable than the conclusion, the Answerer is not bound to grant propositions, however probable, unless their probability is greater than that originally possessed by the conclusion they have to establish. If the Thesis is probable, the conclusion of the Elenchus will be the reverse; and then the Answerer ought to allow premisses which,

[1] Soph. El. 16.

[2] Soph. El. 17.

[3] *δίκαιον μὲν οὐκ εὔσχημον δέ.*—Topics, viii. 12.

οὐ δεῖ συνεστάναι εὐχερῶς πρὸς τοὺς τυχόντας· ἀνάγκη γὰρ πονηρολογίαν συμβαίνειν.—Ibid.

[4] *ὥσπερ γὰρ ἡ ἐν ἀγῶνι ἀδικία εἶδός τι ἔχει, καὶ ἔστιν ἀδικομαχία τις· οὕτως ἡ ἐν ἀντιλογίᾳ ἀδικομαχία ἐστὶν ἐριστική.*—Soph. El. 11.

[5] Soph. El. 34.

[6] Topics, viii. 4.

though not highly probable, still possess a higher degree of probability than the conclusion. If the Thesis is neither probable nor improbable, its contradictory is of the same character, and propositions of but slight positive probability may be fairly claimed. The same rule will hold, whether the probability or improbability is absolute or relative to the creed of the particular Answerer: and if the Thesis is not a tenet of his own, but of some celebrated school or philosopher, reference must be had to what was probable or improbable in that school, or in the views of that philosopher: and if a third person succeeds to the cause of one of the original disputants, he should govern himself by the opinions of the person whom he superseded.

Before we proceed to Solution we will explain certain terms: and we may observe, that there is great precision in the Dialectical nomenclature.

Eristic and Sophistical reasoning are the same, but differ in the motives from which they are employed. A fallacy is Eristic, if prompted by the heat of dispute and the desire of victory: Sophistical,[1] when employed from mercantile motives by a pseudo-philosopher, who makes a trade of imaginary wisdom.

A Sophistry must be distinguished from a Pseudographema: both are fallacies,[2] but the first is Dialectical, the second Scientific. As a sound Dialectical argument differs from a sound Scientific proof, because the latter is confined to a particular subject-matter, while the former is indiscriminately applicable to several; so a Pseudographema is only practicable in a particular department, while a Sophistry is of a Protean character. A Pseudographema[3] then, is defined to be a fallacy constructed of the false principles peculiar to a particular science, and is consequently intransferable.[4]

[1] *σοφιστικοὶ οἱ δόξης χάριν τῆς εἰς χρηματισμόν· ἡ γὰρ σοφιστική ἐστι χρηματιστική τις ἀπὸ σοφίας φαινομένης.*—Soph. El. 11.

καὶ γὰρ ἡ σοφιστική ἐστι φαινομένη σοφία τις ἀλλ' οὐκ οὖσα.—Ibid.

ἔστι γὰρ ἡ σοφιστικὴ φαινομένη σοφία οὖσα δὲ μή· καὶ ὁ σοφιστὴς χρηματιστὴς ἀπὸ φαινομένης σοφίας, ἀλλ' οὐκ οὔσης.—Soph. El. 1.

[2] *παραλογισμοί.*

[3] *οἱ ἐκ τῶν περί τινας ἐπιστήμας οἰκείων γινόμενοι παραλογισμοί.* Topics, i. 1. *ἐκ τῶν ἀρχῶν καὶ τῶν συμπερασμάτων τῶν ὑπὸ τὴν τέχνην ψευδογραφεῖ.*—Soph. Elench. 11. It does not appear that the name was ever applied to any but geometrical fallacies.

[4] *οὐκ ἔστι μετενεγκεῖν διὰ τὸ ἐκ*

A Sophistry or Dialectical fallacy is of three kinds:[1] it is either

(1.) An argument whose premisses are false:

(2.) Whose premisses are inconclusive:

(3.) Or an argument which, though sound Dialectically, is deceptive and Sophistical, because it professes to be Scientific, i. e. to conform to the Appropriate method: or which professes to be Pirastic, i. e. to show a deficiency of the Answerer in his particular science.

As in Scientific proof it is not enough to show the fact, but we must also show the reason of an attribute, so in Solution it is not enough to prove that an argument is fallacious, but we must also point out why it is a fallacy.[2] Such a Solution is by Enstasis, which is either Rejection[3] or Distinction:[4] if a premiss

τῶν ἰδίων εἶναι ἀρχῶν.—Ibid. The following appears to be a case of pseudographema. "Hobbes erroneously held that he had discovered a means of geometrically doubling the cube, a problem which cannot be solved by plane geometry. He proposed a construction for the purpose: and when his critics had proved that one of the lines in his diagram would not meet the other in the point which his reasoning supposed, but in another point near to it, he maintained in reply that one of these points was large enough to include the other, so that they might be considered as the same point."—Philosophy of the Inductive Sciences, book i. 4, § 6. Compare Aristotle's example: *τῷ γὰρ ἢ τὰ ἡμικύκλια περιγράφειν μὴ ὡς δεῖ, ἢ γραμμάς τινας ἄγειν μὴ ὡς ἂν ἀχθείησαν, τὸν παραλογισμὸν ποιεῖται.*—Topics, i. 1.

[1] *ψευδὴς λόγος καλεῖται.*

(1) *ἐὰν διὰ ψευδῶν συμπεραίνηται·*

(2) *ὅταν φαίνηται συμπεραίνεσθαι μὴ συμπεραινόμενος·*

(3) *ὅταν συμπεραίνηται μὲν, μὴ μέντοι πρὸς τὸ προκείμενον·*

(4) *ὅταν πρὸς τὸ προκείμενον μὲν συμπεραίνηται, μὴ μέντοι κατὰ τὴν οἰκείαν μέθοδον.*—Topics, viii. 10.

As the third is a case of Ignoratio Elenchi, in the book on Fallacies (chap. 11), it is included among the second. The fallacy of *non causa pro causâ* would also fall under the third of these heads.—Soph. El. 5.

[2] As the preposition *κατὰ* designates the cause of an attribute, so the preposition *παρὰ* designates the cause of a fallacy.

ἔστιν ἡ Λύσις ἐμφάνισις ψευδοῦς συλλογισμοῦ παρ' ὁποίαν ἐρώτησιν συμβαίνει τὸ ψεῦδος· καὶ ἡ τοῦ φαινομένου συλλογισμοῦ παρὰ τί φαίνεται τῶν ἐρωτημάτων.—Soph. El. 18.

ἦν γὰρ ἡ Λύσις ἐμφάνισις ψευδοῦς συλλογισμοῦ παρ' ὃ ψευδής.—Soph. El. 24.

[3] *ἀναίρεσις.*

[4] *διαίρεσις.* That these were the only legitimate kinds of solution appears from several passages, e. g. *πότερον παρὰ ἀναίρεσιν ἢ διαίρεσιν ἐστὶν ἡ λύσις.*—Soph. El. 33.

is false, it must be pointed out and Rejected: if the premisses are inconclusive, and there is only a semblance of syllogism, we must point out the Distinction that separates it from a real syllogism, and specify the flaw it contains.

If the Answerer could not solve the Elenchus by Enstasis, his last resort was to antisyllogize, that is, produce an independent argument against the conclusion of the Elenchus.

This was however considered insufficient; because, though it might show the falsity of the Elenchus, it did not show how or where it was false: and besides, it broke through the division of labour, by which the offensive was assigned to the Questioner, and the defensive to the Answerer.

An inconclusive Elenchus must bear some resemblance [1] to a genuine Elenchus, or else there could be no deception: its Solution therefore consisted in Distinction,[2] or pointing out where this resemblance failed. There were thirteen different heads of these delusive resemblances, well known under the name of Logical Fallacies, and to be found in the common books of Logic, which we therefore need not explain.

The other kind of Enstasis is Denial, or Rejection. If the reasoning is conclusive and the Answerer refuses to abandon his Thesis, his only alternative is, to show reason why one of the premisses should be Rejected: of course it would have been better never to have made the concession, but if made, nothing is now left but to retract it. His bare negation was insufficient: he had to adduce an Homogeneous, Analogous, or Opposite case, or might appeal to Authority.[3] Enstasis seems to have been restrained to these four topics, because it was desired, as far as possible, to confine the reasoning to the Questioner, and to place

συμβαίνει τῶν λόγων τοὺς μὲν συλλελογισμένους ἀνελόντα τοὺς δὲ φαινομένους διελόντα λύειν.—Soph. El. 18.

ὅπως ἢ ἀναιροῦντες ἢ διαιροῦντες λύωμεν.—Ibid.

ἢ γὰρ ἀναιρεῖ ἢ διαιρεῖ ὁ ἐνιστάμενος.—Topics, viii. 12. *ἐριστικῶς συλλογίζονται, καὶ γὰρ ψευδῆ λαμβάνουσι καὶ ἀσυλλόγιστοί εἰσι.*—Phys. Ausc. i. 3. See also the definition of *λύσις*.

[1] *γίνεται διά τινος ὁμοιότητος.*—Soph. El. 1.

[2] *διαίρεσις.*

[3] Anal. Prior. ii. 28. Rhet. ii. 25. The same laxity was allowed to the Questioner in making a direct proposition.—Topics, i. 8, and 12.

the Answerer in a purely defensive attitude. Why a preference should be given to these particular four is not inconceivable. Authority was a topic peculiarly Dialectical, as appears from the definition of a Dialectical proposition: Propositions relating to Opposites are closely connected, and, *mutatis mutandis*, may be considered identical: and Analogy or Induction is one of the simplest modes of reasoning. An Homogeneous case is either generic, or specific to the subject of discussion.

Yet there was no reason why the other topics should be absolutely excluded: they were admitted, then; but this mode of objecting to a premiss was not considered Enstasis, but Antisyllogism.[1] This latter term then is not only applied to a syllogism framed by the Answerer against the conclusion of the Elenchus, but also to a syllogism directed against a premiss, when it falls under any topic other than the four that constitute the Enstasis.

What is said of Enstasis in the Prior Analytics only applies to Enstasis by Rejection, and only to one of the four forms of this.

In the Rhetoric we have a similar account of Solution,[2] which is divided into Enstasis and Antisyllogism:[3] and we have some further observations on the mode in which the Sign, Tekmerion, Induction, and Verisimilitude are enstatized.

Signs can be always enstatized by Distinction, as they are always inconclusive: the Tekmerion can only be enstatized by Rejection, as its sequence is unexceptionable. It is not a sufficient Rejection of Inductive propositions and Verisimilitudes, to adduce singular exceptions; this only shows they are not universal: but we must also show that they are not general; for generality is enough for the opponent.

The account that has been given of Pirastike will apply with but slight modification to Dialectics in general: the former employs any premisses that the Answerer chooses to grant,[4] be-

[1] This appears from the following passage: *εἰ οὖν μήτε ἀντεπιχειρεῖν ἔχων μήτε ἐνίστασθαι οὐ τίθησι, δῆλον ὅτι δυσκολαίνει.*—Topics, viii. 7.

[2] *ἔστι δὲ λύειν ἢ ἀντισυλλογισάμενον ἢ ἔνστασιν ἐνεγκόντα.*—Rhet. ii. 25.

[3] *ἡ ἔνστασις τὸ εἰπεῖν δόξαν τινὰ ἐξ ἧς ἔσται δῆλον ὅτι οὐ συλλελόγισται ἢ ὅτι ψεῦδός τι εἴληφε.*—Ibid.

[4] *οἱ ἐκ τῶν τοῦ ἀποκρινομένου δοξῶν.*—Soph. El. 2.

cause its object is to discover his views and to test their soundness: whereas Dialectics only employs propositions of an absolute probability,[1] opinions that are current in the public at large.

As the object of the Questioner is to obtain premisses or universals, which, when they are not obvious, must be claimed inductively; and as the object of the Answerer is to withhold them, which cannot be done, if they are at all probable, without specifying his objection, or showing cause why the Induction should not be admitted; Dialectical power, which embraces both of these functions, will consist of two elements;[2] talent of Proposition, and talent of Enstasis; that is, the power of descrying Identity, or Unity in Plurality, and the power of descrying Diversity, or Plurality in Unity.[3] These are the two original gifts of the scientific faculty,[4] called, in the language of Kant, the powers of Generalization and Specification; and not only do they constitute the antagonistic powers in all controversy, the one attempting to construct what the other attempts to destroy, but their harmonious action is required in all positive philosophy, the one providing unity and system, the other multiplicity and articulation.

§ 6. D. We may now proceed to Dialectics as an organ of the Inductive sciences. We have already seen that this is one of the uses of which Aristotle considered it capable.[5] In another place[6] its power of examining hypotheses is pointed out as making it a useful organ for philosophy, and the habit of Enstasis is mentioned as a safeguard to the accuracy of the philosopher's Induction: the Enstasis[7] in this case being limited to

[1] οἱ ἐκ τῶν ἐνδόξων συλλογιστικοὶ ἀντιφάσεως.—Soph. El. 2.

[2] διαλεκτικὸς ὁ προτατικὸς καὶ ἐνστατικός.—Topics, viii. 12.

[3] ἔστι δὲ τὸ μὲν προτείνεσθαι ἓν ποιεῖν τὰ πλείω, τὸ δὲ ἐνίστασθαι τὸ ἓν πολλά.—Ibid.

[4] τούτων ἔγωγε ἐραστὴς τῶν διαιρέσεων καὶ συναγωγῶν· καὶ τοὺς δυναμένους είς ἓν καὶ ἐπὶ πολλὰ πεφυκὸς ὁρᾶν καλῶ διαλεκτικούς.—Plato, Phædrus, § cxi.

[5] πρὸς τὰ πρῶτα τῶν περὶ ἑκάστην ἐπιστήμην ἀρχῶν χρήσιμος ἡ διαλεκτική . . . ἐξεταστικὴ γὰρ οὖσα πρὸς τὰς ἁπασῶν τῶν μεθόδων ἀρχὰς ὁδὸν ἔχει.—Topics, i. 2.

[6] πρὸς τὴν κατὰ φιλοσοφίαν φρόνησιν τὸ δύνασθαι συνορᾶν καὶ συνεωρακέναι τὰ ἀφ' ἑκατέρας συμβαίνοντα τῆς ὑποθέσεως οὐ μικρὸν ὄργανον· λοιπὸν γὰρ τούτων ὀρθῶς ἑλέσθαι θάτερον.—Topics, viii. 12.

[7] δεῖ ἐνστατικὸν εἶναι διὰ τῶν οἱ-

phænomena obtained by exact observation of the subject investigated.

The method of investigating first truths employed by Aristotle[1] is to state the principal phænomena to be accounted for, and then examine the hypotheses that had been proposed for their explanation, and, if none appeared tenable, to advance a theory of his own. This examination would necessarily assume a Dialectical form; the method of criticising all hypotheses would find its highest employment in criticising those offered for our acceptance as supreme scientific laws. These, according to the Aristotelian analysis, would assume the form of definitions; and accordingly, in the following treatise, when we have arrived at the discussion of Definitions, we shall be referred to Dialectics as the final criterion of their correctness.[2]

The point we now stand on is the weak point in the Aristotelian Logic, the weakness that rendered the Baconian revolution necessary before the Physical sciences could be founded on a solid basis. It is true that the Inductive method cannot resemble the Deductive, but it does not therefore follow that it is identical with the method of Opinion. This is recognized by Aristotle himself in the passages quoted above, where the latter is contrasted with the Physical or Inductive procedure. If Opinionative Logic includes all modes of reasoning not purely Demonstrative, then Inductive Logic ought to consist of a selection from these, rigorously excluding all that admit a possibility of error. But no such separate theory or selection seems to have been made by Aristotle, and in his actual investigation of scientific principles we find no rigid abstinence from the more precarious lines of argument.

Besides the laxity of his Topics, he was infelicitous in the objects which he proposed to accomplish by these methods. His account of a commensurate proposition, where the presence or absence of the subject involves the presence or absence of the predicate, cannot but remind us of what Mr. Mill has called the

κείων ἐνστάσεων ἐν τῷ γένει· τοῦτο δ' ἐστὶν ἐκ τοῦ πάσας τεθεωρηκέναι τὰς διαφοράς.—De Cœlo, ii. 13.

[1] See the Philosophy of the Inductive Sciences: on the Explication of Conceptions and Colligation of Facts, book ii.; De Cœlo, i. 10; Met. i. 3; Met. iii. 1; De Animâ, i. 1 and 2.

[2] Post. Anal. ii. 12.

Methods of Agreement and Difference; and if, instead of Topics to establish the various kinds of Predicable, Aristotle had set himself to ascertain rigorous methods for the determination of such propositions, he might have approximated much nearer to the perfection of the modern Logic. Although the ultimate laws may appear in the form of Definitions, it is a great mistake, as Bacon often observes, to proceed too precipitately to the discovery of these, instead of gradually advancing to them through laws of increasing generality from the primary laws, the immediate generalizations of phænomena. Rules for the ascertainment of causal connections would have been more valuable than methods for the establishment of the Predicables: but though a scientific definition should express the cause of the object defined, no notice is taken of this in the Dialectical Topics for the establishment of Definition. A proposition expressing a Property is commensurate, but if we examine the Topics for Property, we shall find that they rather relate to the incidents of verbal controversy, than to the establishment of scientific laws.

Plenty of writers have declaimed in vague terms against the old method of investigating principles, but none has indicated the exact points in which it differed from the new. And yet our knowledge of the latter would be more complete, if we knew its relation to the one it superseded; and now that the true method is so firmly established, there is no reason for exaggerating the defects of the old, or danger in acknowledging the degree, whatever it was, in which it approximated to the truth.

Besides the circumstance already mentioned, the laxity of the Topics, or methods of arguing from phænomena, and the infelicitous choice of the ends proposed to these Topics, another vice in the old system was the paucity of these original phænomena, and the carelessness with which they were collected.

We have a general recognition of the fact that the Physical sciences must rest on induction, both in the passages already cited, and in others that might be adduced;[1] for Aristotle

[1] εἰρήκασι μὲν, οὐ καλῶς δὲ, ἀλλ' ἀπειροτέρως τῶν συμβαινόντων.—De Respir. 1. διὸ τὰς μὲν ἀρχὰς τὰς περὶ ἕκαστον ἐμπειρίας ἔστι παραδοῦναι . . . . ληφθέντων γὰρ ἱκανῶς τῶν φαινομένων οὕτως εὑρέθη-

stands in about the same relation to his predecessors in which Bacon stands to himself, and the expressions he uses in criticising their method often reminds us of the language of Bacon.[1]

Indeed the apparent similarity of Bacon's method to that which it proposed to supplant, was one of the greatest obstacles to its introduction. For it appeared to have already had its trial, and if theoretically it might contain some minute points of difference, it was expected that these would vanish in the unavoidable shortcomings of practice. Still the prejudice against Sense created by the enthusiastic declamations of the ancient Rationalists was perhaps not completely eradicated, and the mathematical precision with which phænomena are now measured, and the method with which they are registered, did not enter into the Aristotelian conception of Induction: and we have an example how near the mind may approach to the recognition of a principle, and yet remain in darkness; and how enormous a difference results from the complete possession of a great idea, and the half-true state of mind, that has partly given in its adherence to the truth, and partly remains in compromise with error.

But a still greater defect than the faultiness of its Observation was the complete absence from the system of the idea of Experiment. Observation takes cognizance of the phænomena which nature presents of her own accord; whereas Experiment creates others for itself, and has the advantage, where it is applicable, of selecting the conditions under which it will view the subject-matter, under which perhaps it is never presented by nature; and of knowing precisely what these conditions are, as they proceed from our own arrangement: whereas in Observation we are often uncertain whether we have noticed all the antecedents and concomitants of a given phænomenon. Hence it is that Aristotle's success is very different in the sciences that rest on Observation and those that rest on Experiment. In the Poli-

σαν αἱ ἀστρολογικαὶ ἀποδείξεις .... *εἰ γὰρ μηδὲν κατὰ τὴν ἱστορίαν παραλειφθείη τῶν ἀληθῶς ὑπαρχόντων τοῖς πράγμασι*, &c.—Prior. Anal. i. 30.

[1] Compare: *οἱ δ' ἐκ τῶν πολλῶν λόγων ἀθεώρητοι τῶν ὑπαρχόντων ὄντες πρὸς ὀλίγα ἐπιβλέψαντες ἀποφαίνονται ῥᾷον*, De Gen. et Cor. i. 2, with Bacon's: Istud respicere pauca et pronunciare secundum pauca perdidit omnia.

tical sciences which rest on Observation, or rather on Experience, that is, where under any tolerable state of society Nature herself is sure to supply the sensations requisite for eliciting the ultimate laws and dominant ideas, it would be difficult to find any writer in later times by whom he has been surpassed or equalled: and his Zoological treatises, where Observation rather than Experiment was required, are spoken of with high praise by modern naturalists. In Chemistry, on the other hand, of which the beginning, middle, and end is Experiment, he was completely unsuccessful; and an error in so elementary a science could not fail to be widely felt in the other branches of his Philosophy.

He complains of the difficulty of discovering primary laws, and seems to confess the unfinished state of Inductive Logic.[1]

So much for his Inductive Method.

The treatises contained in the Organon, though incomplete, perhaps take us over most of the ground that should be explored by Logic. One important deficiency is the method of the Metaphysical sciences: for the evolution of Metaphysical ideas cannot be inductive, as their objects do not belong to the sensible world. Aristotle may have acquiesced in the views of Plato, who seems to hold that the highest ideas of Reason are developed by lower but analogous perceptions.[2]

Some Logical doctrines might be gathered from the other works of Aristotle, such as that which Kant calls the Maxim of Parsimony.[3] The Organon is by no means all that Aristotle wrote on the subject of Logic. In the list of his works given by Diogenes Laertius we find about twenty other Logical treatises: among them the Methodica, quoted in the Rhetoric, and consisting, according to Laertius, of eight books; which probably con-

[1] πάντη δὲ καὶ πάντως ἐστὶ τῶν χαλεπωτάτων λαβεῖν τινὰ πίστιν περὶ τῆς ψυχῆς· καὶ γὰρ τάχ' ἄν τῳ δόξειε μία τις εἶναι μέθοδος κατὰ πάντων περὶ ὧν βουλόμεθα γνῶναι τὴν οὐσίαν, ὥσπερ καὶ τῶν κατὰ συμβεβηκὸς ἰδίων ἀπόδειξιν· εἰ δὲ μή ἐστι μία καὶ κοινή τις μέθοδος περὶ τὸ τί ἐστιν, ἔτι χαλεπώτερον γίνεται τὸ πραγματεύεσθαι· δεήσει γὰρ λαβεῖν περὶ ἕκαστον τίς ὁ τρόπος.—De Animâ, i. 1.

[2] ἐπανιέναι ὥσπερ ἐπαναβαθμοῖς χρώμενον.—Plat. Symposium.

[3] φανερὸν ὅτι μακρῷ βέλτιον ὡς ἐλαχίστας ποιεῖν τὰς ἀρχάς, πάντων γε τῶν αὐτῶν μελλόντων δείκνυσθαι, καθάπερ ἀξιοῦσι καὶ οἱ ἐν τοῖς μαθήμασιν.—De Cœlo, iii. 4.

tained a more systematic view of the whole of Logic than any of those that survive.

We now conclude our sketch of the Organon, which we have divided into four parts; General Logic, the Logic of Deduction, the Logic of Induction, and the Logic of Opinion: the third indeed not sufficiently articulated and disengaged from the fourth, and hence the necessity of a Novum Organum.

THE

POSTERIOR ANALYTICS.

BOOK I.

CHAPTER I.

ON REASONING.

§ 1. All teaching and learning by way of inference proceed from pre-existent knowledge. Of this we may be satisfied by examination of instances: it is thus that the Mathematical sciences and the Arts are acquired; the Dialectician's Induction and Syllogism both appeal to previous knowledge, the one of the phænomenon, the other of the law: and the Orator persuades by Example and Enthymeme, the one a kind of Induction, the other of Syllogism.

§ 2. The previous knowledge is twofold: it is a Judgment, and affirms the existence of an object: or it is a Conception, and comprehends its nature: or it is a union of both. That one or the other of two contradictories is necessarily true, must be affirmed in a Judgment:[1] the nature of the triangle must be comprehended in a Conception: and we must both comprehend the nature of the Unit and affirm its existence: and these elements of knowledge have not always the same evidence.

§ 3. When, however, implicit knowledge is rendered explicit, the universal premiss may be antecedent to the conclusion, while the singular is simultaneous.[2] If, for instance, the equality of the interior angles of every triangle to two right angles is antecedently known, [3]as soon as the existence of a particular triangle in the semicircle is given by observation, (for

[1] We have here the three kinds of scientific principle, which we shall presently find are Axioms, Definitions, and Hypotheses.

[2] γνωρίζειν, actual knowledge, is opposed to ἔχειν τὴν γνῶσιν, implicit knowledge. See Prior. Anal. ii. 23. and Nic. Eth. vii. 3.

[3] The same example of immediate perception is adduced, Nic. Ethic. vi. 8.

singular premisses are objects not of inference, but of observation,) our knowledge of the conclusion is simultaneous.

§ 4. Before the minor is observed and the syllogism constructed, the conclusion is in one point of view known, in another unknown. Before we know the existence of a subject, we cannot without qualification be said to know what attribute it possesses: we may be said to know it implicitly, or in the universal; but only with such a limitation. This is the way we must solve the dilemma in the Meno, by which it is argued that we can learn nothing, or else only what we already know.[1] The other solution (which denies that we know the universal when ignorant of the particular) is inadmissible. If you profess to know a universal, for instance, that all Twos are even, they refute you by producing a Two whose existence was unknown to you, and whose evenness consequently, they argue, you cannot have known; maintaining, that you knew, not that all Twos were even, but that every Two, whose existence was known to you, was even. This is inadmissible; for your knowledge was derived from demonstration; and demonstration makes no reserve of the kind, but pronounces upon all triangles and numbers without exception. The true solution then is, that you knew in one sense what you were ignorant of in another. It is not inconceivable that we should learn what we already know in a different point of view: but it would be, that we should know and not know one and the same thing in one and the same point of view.

[1] See Meno, § 14. It was argued that inquiry is useless, and that nothing can be learnt: for what is known is not an object of inquiry; and what is unknown it is useless to search for, as it could not be recognized even if found: and to say that the same thing might be both known and unknown, seemed to violate the Axiom which asserts that no subject is capable of contradictory predicates.

In modern times, the fact that we have an implicit knowledge of the conclusion when we know the premisses, has brought on the syllogism the charge of *petitio principii*.

CHAPTER II.

SCIENTIFIC PRINCIPLES.

§ 1. Absolute science, as distinct from the Sophist's[1] accidental science, is, according to the common conception, Knowledge of the necessity and the reason of a law. Science must be this: for both the real and the fancied possessors of absolute science ascribe to it the investigation of necessary laws. We may afterwards see if there is any other kind. It is certain there is such a thing as demonstrative knowledge: demonstration means scientific proof: and the possession of scientific proof is science.

Assume this definition, and the premisses of demonstrative science must be true, elementary, immediate, clearer than the conclusion, antecedent, and causal; and then the principles will be appropriate to the conclusion. Proof may exist without these conditions, but not science nor demonstration.

§ 2. The premisses must be true. Science cannot be false: we cannot know that the diameter is commensurate.

§ 3. They must be elementary, and indemonstrable; else they will need demonstration: for the demonstrable is only essentially known by demonstration.

§ 4. They must be causal of the conclusion, clearer, and antecedent: causal, because to know the cause is the very essence of science: antecedent, both as causal and as foreknown: foreknown, not only as conceptions, but also as propositions.[2]

Priority and pre-evidence are of two kinds. What is naturally prior and clearer is not prior and clearer to man: the objects which are farther from sense are absolutely prior and clearer: those which are nearer to sense are prior and clearer to man.

[1] The predicate of a scientific proposition is Essential: the predicate of a dialectical proposition is Accidental: a proof founded on dialectical propositions and professing to be scientific, is Sophistical.

[2] That is, the principles of Science must include Hypotheses, or Postulates, as well as Definitions.

The latter are particulars, the former universals, so that they are opposites to one another.

§ 5. They will be elementary because they are the appropriate principles: for Element and Principle are synonymous. A demonstrative principle is an immediate or proximate proposition. A proposition is either of two enunciations, and has a single subject and predicate: if dialectical, it offers an alternative: if demonstrative, it determines which is true. Enunciation is either of two contradictories. Contradiction is opposition which excludes an intermediate: the side which conjoins subject and predicate is affirmative; that which disjoins them is negative.

§ 6. Immediate syllogistic principles are either Theses;[1] that is, are indemonstrable, but not the necessary antecedents of all inference: or Axioms; that is, are indispensable for any progress in knowledge. Such principles as the latter there are, and this is the name we generally give to them.

A Thesis may be one side of an enunciation, and assert the existence or non-existence of a subject; and is then called an Hypothesis: or it makes no assertion, and is called a Definition.

The arithmetician, when he defines the Unit as an indivisible quantity, makes a Thesis, but not an Hypothesis: for to unfold the essence of a subject is not the same as to affirm its existence.

§ 7. Belief and knowledge of the law being grounded on demonstration, and this standing in the strength of elementary laws, some or all of the elementary laws must be not only foreknown, but with a higher knowledge than the conclusion: the cause which imparts a predicate to a subject always possessing that predicate in a more eminent degree: as the primary object of affection is dearer than another object which is loved for its sake. The primal laws, the origin of our knowledge and belief, must be the object of higher knowledge and belief than the derivative laws of which they are the vouchers. Now a truth cannot be believed more than other truths which are known, unless itself the object of knowledge: the grounds of demonstration are therefore the objects of knowledge, as some or all of them must

[1] The Theses correspond to the specific principles of Rhetoric, and to the Organa of Dialectics: the Axioms correspond to the Maxims or Topics of Rhetoric and Dialectics. For an account of the Axioms and Hypotheses, see Appendix A and B.

be grasped with a firmer faith than the demonstrated law. And knowledge and faith in the primary truths must not only be greater than that in the conclusion, but also than that in any of the opposite principles, from whence the antagonistic errors might be educed. For perfect science must be impregnable.

CHAPTER III.

THE FIRST TRUTHS ARE KNOWABLE, BUT NOT DEMONSTRABLE.

§ 1. From the necessity of knowing the primary laws, some have maintained that science is impossible; others, that science is possible and all laws demonstrable: neither of which doctrines is necessary or true.

The impossibility of science is maintained by a dilemma: Either there is no limit to the regression, no primary law; and then, as we cannot traverse an illimitable series of antecedent laws, there can be no science: or, if there is a limit to the regression, as demonstration is the only source of science, the primary indemonstrable laws must be unknown, and the conclusion merely hypothetical, not categorical and scientific.

The others, though they hold, with these, that demonstration is the only source of science, contend that all laws are demonstrable by a reciprocal and circulating evidence.

We maintain that demonstration is not the sole source of science; that the science of immediate truths is not demonstrative. If we demonstrate by prior and more elementary laws, the immediate laws, where regression ceases, must be indemonstrable.[1] Further, we assert that, besides science, man possesses a faculty that begins science, the faculty of Ideas.

§ 2. Absolute demonstration cannot be circular, for these reasons. Firstly, the ground of demonstration is prior and more evident than the conclusion; and one and the same law cannot be both prior and more evident, and posterior and less evident. It may possess the one character absolutely, and the

[1] This question is resumed chap. xix—xxii.

other relatively to man: and it is its relative character which determines its position in Induction. But our definition of absolute science need not be enlarged; for that which is merely prior to man cannot be the ground of absolute demonstration.[1] Secondly, circular demonstration only proves that a theorem is true, if it is true: in which manner any theorem may be established. Assume three terms (for it is immaterial how many or few terms compose the circle). In regular proof, when theorem A establishes theorem B, and this again theorem C, we have theorem A in warrant for theorem C. In circular proof, A recurs instead of C; so that theorem A is warrant for theorem A. Any theorem may be thus warranted. Thirdly, even this proof is impossible except for reciprocals, such as properties. One term or premiss gives no conclusion: two premisses make an elementary syllogism. We showed, when speaking of syllogism, that if the terms A, B, C, reciprocate, all their possible conjunctions are capable of circular proof in the first figure: and we also showed that it could not be constructed in the other figures. Only propositions that are simply convertible are capable of circular proof; and as these are rare, it is an idle and untenable assertion that demonstration is circular, and all truths demonstrable.[2]

CHAPTER IV.

UNIVERSAL, ESSENTIAL, COMMENSURATE.

§ 1. The conclusions of absolute science are necessary: the premisses of demonstration therefore are necessary. In order to examine their character, let us define Universal, Essential and Commensurate.

§ 2. An attribute is universal that is possessed by a class, without exception of individuals or of times. Animal is a universal predicate of Man: and wheresoever and whensoever we can predicate Man, we can also predicate Animal. Point is a

[1] Knowledge is not Science till it has reached the deductive state.

[2] See, however, book ii. 11.

universal attribute of Line. For we assail a universal proposition by adducing an individual of which, or a time when, the predicate is not true.

§ 3. An attribute is essential that enters into the conception of the subject:[1] as Line enters into the conception of Triangle, and Point into the conception of Line. It helps to compose the essence of the subject, and it is found in its definition.

Or, it is an attribute in whose definition the subject is contained.[2] Straight and Curved are attributes of Line; and even and odd, prime and compound, square and scalene, of number: and we cannot define them without mentioning the subjects they attach to, line and number. Those predicates which satisfy neither of these conditions are accidental: as White and Musical with reference to Animal.

In another sense, that is essential which is not ascribed to any subject as an attribute: as Substance, which requires nothing else as substratum of its existence. What is thus ascribed is accidental. White and Walking are ascribed to a subject that is white and walks. In another sense, a concomitant that is caused by an antecedent is essential. Death is an essential concomitant of Beheading. . But it is accidental that it lightens while you walk.

In the essential propositions of absolute science, the subject is either contained in the definition of the predicate, or contains the predicate in its own definition; the essence of the terms is the cause of their conjunction: and their conjunction is necessary. The subject necessarily possesses a determinate predicate, or at least the alternative of two contraries. Line must be either Straight or Curved; Number must be either Odd or Even. Contrariety is the privation or contradiction of a quality, in a subject of the same kind as another which possesses the quality. That which is not odd, and belongs to number, the class to which oddness attaches, is even. Therefore, as

[1] From the force of the preposition, *καθ' αὑτὸ* includes the notion of Causation. A predicate is essential when the subject itself (*αὐτὸ*), or its essence, is the cause of its connection with the predicate: *ὑπάρχει κατ' οὐσίαν καὶ κατὰ τὸ εἶδος*, ch. xxxiii. *ᾧ γὰρ καθ' αὑτὸ ὑπάρχει τι τοῦτο αὐτὸ αὑτῷ αἴτιον*, ch. xxiv.

[2] Met. vii. 5; Phys. Ausc. i. 3; *οὐ ὑπάρχει ἐν τῷ λόγῳ τοῦτο ᾧ συμβέβηκε*. Also Post. Anal. i. 22.

one or the other of two contradictories must be true, one or the other of such essential predicates must be true.[1]

§ 4. A [2]commensurate attribute is universal and essential, and belongs to the subject as it is what it is, and is therefore necessary. The term, Essential, is equivalent to the term, As it is what it is. A line Essentially, and As it is what it is, contains a point, and is straight. A triangle Essentially, and As it is what it is, contains angles equal to two right angles.

An attribute is commensurate to the primary or highest genus of which it is universally predicated. The attribute of containing angles equal in sum to two right angles is predicable of Figure, but not universally. It is predicable of Isosceles triangle, universally but not primarily. It is universally, and primarily predicated of Triangle. Where it is both universally and primarily predicable, it is commensurate. Of Triangle it is demonstrated primarily, commensurately, and essentially. To Isosceles triangle it is not commensurate nor essential.

CHAPTER V.

COMMENSURATE.

§ 1. It often happens that a conclusion is not primary and commensurate, when it seems to be. When there is no genus of the individual or individuals; or when there is a genus, but a nameless one, and the individuals differ in species; or when the predicate has been proved of a species; we are liable to this mistake. The conclusion, though not primary and commensurate, is universal. If not primary and commensurate, the demonstration is not essential. Perpendiculars to the same line are parallel; but this is not an essential proposition; for not

[1] This principle is the Axiom.

[2] *καθόλου* is generally translated Universal, but it was necessary to use another word, in order to distinguish it from *κατὰ παντός*. In Aristotle's other works they are used as synonyms: and even in the present his practice is not uniform, so that sometimes it is uncertain how *καθόλου* should be translated. In book ii. 14 the definition is expressly abandoned.

only perpendiculars, but all lines that meet another at equal angles, are parallel. Were the isosceles the only triangle, the property of containing angles equal to two right angles would seem essentially connected with isoscelism. The permutation of proportionals, numbers, lines, solids, times, is not essentially connected with number, time, dimension, but can be demonstrated at once of the commensurate genus. It was formerly proved in detail. They differ in species, and there was no name for their genus. When you prove in detail of each species of triangle, equilateral, scalene, isosceles, the equality of their interior angles to two right angles, you may exhaust the possible cases, but your predicate is not essential and commensurate, and you have only a sophistical science. Your Universal, though numerical, is not Essential.[1]

§ 2. What is the criterion of a scientific and commensurate conclusion? If Triangle is essential to the predicate, and the essence of Isosceles is the same as the essence of Triangle, the conjunction of Isosceles and the predicate is Scientific. What subject is essential, primary, and commensurate? The primary or lowest genus, that cannot be eliminated without the destruction of the predicate.[2] The interior angles of a brazen isosceles triangle are equal to two right angles. Brazenness and Isoscelism may be eliminated, but not Figure. But lower genera than Figure are also ineliminable. If Triangle is the primary or lowest ineliminable genus, it is essential and commensurate.

[1] Essential propositions are founded on definitions (see chap. iv), and the object of definition is the εἶδος. See also chap. xxxiii, ὑπολήψεται ὑπάρχειν κατ' οὐσίαν καὶ κατὰ τὸ εἶδος. The knowledge, then, of the εἶδος is necessary for science, according to Aristotle as well as Plato; their difference of view on this subject affects their Metaphysics, not their Logic.

[2] Commensurate propositions should be the objects proposed for discovery by the methods of Induction. See Mr. Mill's System of Logic, book ii.

CHAPTER VI.

SCIENTIFIC PRINCIPLES NECESSARY, THEREFORE ESSENTIAL.

§ 1. Scientific conclusions are necessary, and are therefore educed from similar premisses. This condition is not satisfied by accidental attributes, but is by essential: for here the predicate enters into the definition of the subject; or the subject enters into the definition of the predicate, and must exhibit one of two contraries. The premisses of demonstration are therefore essential.

§ 2. Or we might have proved the necessity of demonstrative premisses by assuming the necessity of the demonstrative conclusion. And if the premisses are necessary, not merely true, the proof is demonstrative. We imply the necessity of demonstrative premisses, when we assail a supposed demonstration by urging that there is no necessity in the conclusion, or none evinced by the proof. It is therefore a great mistake to suppose that our principles are rightly selected, if only probable and true: as the Sophists assume, that to know is the possession of knowledge.[1] A principle requires more than probability and truth; some truths are inappropriate. A principle is the elementary law appropriate to a particular subject-matter.

Another consideration will prove the necessity of the premisses. You have no science of the demonstrable till you can explain its reason. If the major term is a necessary predicate of the minor, and the middle term of your demonstration is not necessary, you cannot explain the reason. If your middle term is not necessary, it cannot explain the necessity of the conclusion.

Again, if at present you have no knowledge of a truth, which remains unaltered, while you remember your former reason; you had no knowledge before.[2] If your middle term is not necessary, it may cease to be predicable: then, remembering your former reason, you will not know the truth, which remains unaltered. If the middle has not actually ceased, but may pos-

[1] See Plato, Euthydemus, § 16.

[2] This argument is taken from the Theætetus, § 55.

sibly cease, such a situation is possible, and such possibility is inconsistent with science.

A conclusion may be necessary, though the middle by which we prove it is contingent; just as it may be true, though the premisses by which we establish it are false. But if the middle is necessary, the conclusion must be necessary; as it must be true, if the premisses are true. A is a necessary predicate of C, if A is necessary to B, and B to C. If the conclusion is contingent, the middle cannot be necessary. Let A be a contingent predicate of C. If A were necessary to B, and B to C, A would be necessary to C: which is contrary to hypothesis. In demonstrative science the conclusion is a necessary law; and if your middle term is not necessary, you will not know the reason of the necessity, nor even the necessity, of the law. Should you indeed mistake contingent premisses for necessary, you will believe without knowledge the necessity of the conclusion: without this mistake, you cannot even believe in the necessity of the law, neither knowing the fact from mediate, nor the reason from immediate premisses.

§ 3. Unessential attributes are not objects of demonstrative science: they cannot be necessarily concluded. It may be asked of what use they are as premisses in Dialectics, if they do not necessitate the conclusion. Do we not first make some irrelevant remarks, and then assert the conclusion, when we argue from contingent premisses? To which we answer, that they are not propounded as grounds of a categorically necessary conclusion; but because, if they are conceded, by a hypothetical necessity the conclusion is conceded; and if they are true, by a hypothetical necessity the conclusion is true.

§ 4. Essential attributes, then, are necessary to their peculiar subject-matter, and form the conclusion and premisses of scientific demonstration. Accidents, not being necessary, and even if universal, not essential, do not teach the reason of a law. This happens in proof by signs. The conjunction may be essential, but you do not know it as such, nor do you know its reason. You know the reason when you know the cause; and when the conjunction of the terms of your syllogism, major and middle, middle and minor, is caused by their own essence.

CHAPTER VII.

SCIENTIFIC PRINCIPLES ARE APPROPRIATE AND INTRANSFERABLE.

§ 1. One science cannot employ proofs borrowed from another.[1] Geometrical truth cannot be proved by Arithmetic. For demonstration is analyzable into three elements;[2] the demonstrated major, an attribute essential to a particular matter; the axioms, or syllogistic canons; and the subject-genus, whose properties and essential attributes are proved. Of these the axioms, or syllogizing powers, are common to all sciences. But if the subject-genus of Geometry is different from the subject genus of Arithmetic, Geometrical attributes cannot be proved by Arithmetical demonstration. Such transference

[1] "But, in order that we may make any real advance in the discovery of truth, our ideas must not only be clear; they must also be *appropriate*. Each science has for its basis a different class of ideas; and the steps which constitute the progress of one science can never be made by employing the ideas of another kind of science. No genuine advance could ever be obtained in Mechanics by applying to the subject the ideas of space and time merely; no advance in Chemistry by the use of mere Mechanical conceptions; no discovery in Physiology by referring facts to mere Chemical and Mechanical principles. Mechanics must involve the conception of *Force*; Chemistry the conception of *Elementary Composition*; Physiology the conception of *Vital Powers*. Each science must advance by means of its *appropriate* conceptions. Each has its own field, which extends as far as its principles can be applied."—Philosophy of the Inductive Sciences, book ii. 2.

[2] *εἰ δὲ ἀποδεικτικὴ περὶ αὐτῶν ἔστι, δεήσει τι γένος εἶναι ὑποκείμενον, καὶ τὰ μὲν πάθη τὰ δὲ ἀξιώματα αὐτῶν· ἀνάγκη γὰρ ἔκ τινων εἶναι καὶ περί τι καί τινων τὴν ἀπόδειξιν.* Met. iii. 2. *εἴπερ πᾶσα ἀποδεικτικὴ περί τι ὑποκείμενον θεωρεῖ τὰ καθ' αὑτὰ συμβεβηκότα ἐκ τῶν κοινῶν δοξῶν· περὶ οὖν τὸ αὐτὸ γένος τὰ συμβεβηκότα καθ' αὑτὰ τῆς αὐτῆς ἔστι θεωρῆσαι ἐκ τῶν αὐτῶν δοξῶν.* —Ibid. See Post. Anal. ii. 12.

would be possible, as will be shown, if Number were the genus of Magnitude; for Arithmetical and all scientific demonstration always expresses its peculiar subject; and unless the subject is wholly or partly the same, the demonstration is intransferable and incommunicable to any other genus:[1] for if the middle and major are not homogeneous to the minor, they are accidental attributes and unessential.

§ 2. Geometry, therefore, will not demonstrate that Contraries are simultaneously known; nor that the product of two cube numbers is a cube: nor will any science establish a theorem for another, unless they stand in the relation of genus and species, as Geometry and Optics, Arithmetic and Harmonics. Geometry will not even investigate all attributes of Lines; not those which are unessential, and do not derive from her peculiar and appropriate principles. It will not discuss whether the straight line is the line of beauty, or whether it is contrary to the circular; these attributes not attaching to their particular genus, but to something it holds in common with other genera.

CHAPTER VIII.[2]

SCIENTIFIC PRINCIPLES ARE ETERNAL.

§ 1. If the premisses of absolute demonstration and science are commensurate, the conclusion must be eternal. Transient

[1] A dialectical proposition or proof differs from a scientific in being applicable to several subject-matters. The terms used by Aristotle to express this character are: *μεταβαίνειν* (*οὐκ ἔστιν ἐξ ἄλλου γένους μεταβάντα δεῖξαι.*—Chap. vii. *εἰ μέλλει ἡ ἀπόδειξις μεταβαίνειν.*—Ibid.) *μεταφέρειν* (*διὰ τὸ μεταφερόμενον ἕκαστον μὴ ὁμοίως εἶναι δῆλον.*—Soph. Elench. 32. *πρὸς πολλοὺς ἔστι μετενεγκεῖν.*—Ibid. 11.) *ἐφαρμόττειν* (*ἐπ' ἄλλων ἐφαρμόττουσιν οἱ λόγοι οὐ συγγενῶν.*—Post. Anal. i. 9. *οὐ γὰρ ἂν ἐφήρμοττεν ἡ ἀπόδειξις καὶ ἐπ' ἄλλο γένος.*—Ibid. *ἕτεραι τῷ γένει αἱ ἀρχαὶ καὶ οὐδ' ἐφαρμόττουσαι.*—Chap. xxxii.) *ἁρμόττειν.*—(Soph. Elench. 11. Also ibid. 20, where it is applied to Solution. *τῶν γὰρ παρὰ ταὐτὸν λόγων ἡ αὐτὴ λύσις· αὕτη δ' οὐχ ἁρμόσει ἐπὶ πάντας.* *διαβαίνειν* (*οὐ γὰρ ἦν ἐξ ἄλλου γένους εἰς ἄλλο γένος διαβῆναι τὰ δεικνύμενα.*—Post. Anal. i. 23.)

[2] This chapter appears misplaced, as it interrupts the connexion between chapters vii. and ix. It might come before chapter vii.

and perishable attributes, therefore, being temporary and incommensurate, are objects of accidental, not absolute science and demonstration. If you prove their actual existence, your minor premiss must be perishable and incommensurate, because the conclusion is perishable and incommensurate. The perishable, if indemonstrable, is also indefinable;[1] definition being either the premiss of demonstration, or the conclusion, or the whole demonstration dislocated. In investigating temporary predicates, like the moon's eclipse, your conclusion must be particular in order to be temporary: if it were universal, it would be eternal.

CHAPTER IX.

THERE IS NO UNIVERSAL SCIENCE.

§ 1. If demonstrated predicates are essential, and the premisses of demonstration peculiar to the subject, science is something more than proof by true and indemonstrable and immediate propositions. For such a proof, like Bryso's squaring of the circle, may conclude by a cause that is not peculiar to the subject, but attributable to other genera, and be transferable to a heterogeneous matter. If the essence of the subject and not an accident is the cause of your knowledge, the demonstration is not transferable to another genus. Our knowledge of a predicate is merely accidental, unless we attribute it to its essential subject, evolving it from the elements of its subject's essence; as we know the attribute of containing angles equal to two right angles from the elements of the essence of that subject to which it is essential. That subject must again be the essential predicate of an antecedent subject, and the middle term and extremes are therefore always homogeneous.

§ 2. We know indeed Harmonic laws by Arithmetical proof, and this knowledge is legitimate: for though the laws are stated by an inferior and separate science, the subject-matter being heterogeneous; the proof is given by the higher science, with whose subject the predicate is essentially connected. Even

[1] See book ii. chap. 9.

in this case it appears that there is no absolute demonstration except from appropriate principles: the appropriate principles of Harmonic theorem being generic and Arithmetical.

§ 3. The peculiar principles of each particular genus are indemonstrable:[1] else the principles of such demonstration would be universal, and we should have one sole and universal science. For if science is more perfect the more primary the causes from which it deduces, a science deducing from uncaused and absolutely antecedent causes would alone be perfect and absolute. But demonstration is not transferable, except between genera related like those of Harmonics and Arithmetic, and those of Optics or Mechanics and Geometry.

To discriminate absolute science from unscientific belief is not easy: for it is not easy to determine what knowledge is based on the principles appropriate to the subject-matter. Deduction from true and elementary propositions passes for science: but besides this, the principles and conclusions ought to be homogeneous.[2]

[1] This, and in general the doctrine of Appropriate principles, seems directed against Plato, who apparently held that the principles of the particular sciences might be obtained by deduction from the principles of the primary science. See ch. xxxii.

[2] We have here, apparently, the ground on which Aristotle differed from Plato as to the relation of Ethics (*φρόνησις*) to Metaphysics or Natural Theology (*σοφία*). The Supreme Good contemplated by the one is heterogeneous to the Supreme Good contemplated by the other. That contemplated by Metaphysics is a substance (*ἐν τῷ τί ἐστιν Ἀγαθὸν ὁ Θεός*, Nic. Eth. i. 6.), and self-existent (*χωριστόν* ibid.), eternal and unchangeable (*ἀκίνητον*), and the absolute Best (*τὸ Ἄριστον ἐν τῇ φύσει πάσῃ*, Met. i. 2.): whereas the subject of Ethics, Virtue or Happiness, is an attribute (*ἀχώριστον*) producible (*πρακτὸν* i. e. *κινητὸν*), and merely the relative Best (*τὸ τῶν πρακτῶν ἄριστον*). As they are thus heterogeneous, it is impossible to pass by scientific deduction from the nature of the one to the nature of the other. Ethics therefore cannot be, as Plato considered (de Repub. 6.), a deduction from Theology.

CHAPTER X.

HYPOTHESES.

§ 1. First principles are indemonstrable propositions. They are either the definition of the elementary, its combinations and attributes, as Unity, Triangle, Curve; or the affirmation of the existence of the elementary, as unity and magnitude. The existence of the compound and of the predicates must be established in the conclusions.

§ 2. Of demonstrative principles some are peculiar to each separate science; as the definitions of Line and Curve to Geometry: others in an analogous, not an identical, form are common to all sciences: as the principle, that if equals be taken from equals, the remainders are equal. A particularized statement is as useful as the most universal formula to a particular science. We only want the specific form that refers to our own genus. The Geometrical form of the axiom will suffice the geometrician, the Arithmetical form the arithmetician.

§ 3. Among the peculiar principles science assumes, are the existence and definition of the subject whose essential laws she has to trace. Arithmetic assumes the existence and definition of Unity; Geometry of points and lines. They further assume the definition of the essential attributes—Arithmetic of odd and even, square and cube; Geometry of angular, inclined, incommensurate. The existence of the attributes is demonstrated by the axioms and former conclusions.

§ 4. The same is true in Astronomy. For in all demonstrative science there are three elements: the Subject, whose existence is assumed, and whose essential laws are developed; the Axioms, which belong alike to every science; and the Attributes, of which we assume the definition, and demonstrate the existence. When any one of these is obvious, it will be neglected: if the existence of the subject is obvious, an Hypothesis is not needed. It is not equally necessary in Arithmetic and Chemistry. If the definition of a predicate is obvious, it may be omitted. The meaning in the axiom of subtracting equals from equals is too

plain for definition. But really there are always three elements; the subject, the attribute, and the proving canon.

§ 5. The Axiom, being a necessary truth and necessarily believed, is distinct from Hypothesis and from Petition or Postulate.[1] I say necessarily believed, though some have attacked the axiom; for demonstration and syllogism depend on the mental, not the spoken proposition. You may always assail the expression, but not the thought.[2]

§ 6. What is capable of proof, but assumed without proof, if believed by the learner, is, relatively to the learner, though not absolutely, an Hypothesis; if the learner has no belief or a disbelief, it is a Petition: and this is the difference. Petition is an assumption opposed to the belief of the learner: or, still wider, a demonstrable proposition assumed without demonstration.

§ 7. Definition is distinct from Hypothesis, for it affirms no existence. Definition needs only be understood, and this is not

[1] (τὸ ἀξίωμα) ἀρχὴ ἀνυπόθετος· ἣν γὰρ ἀναγκαῖον ἔχειν τὸν ὁτιοῦν ξυνιέντα τῶν ὄντων τοῦτο οὐκ ὑπόθεσις.—Met. iv. 3. From the inferior evidence of the existential proposition some have said that all demonstrative science is hypothetical; this is not Aristotle's view, as he includes the hypothesis, or categorical element, among the first principles of Demonstration.

[2] οὐκ ἔστι γὰρ ἀναγκαῖον, ἅτις λέγει ταῦτα καὶ ὑπολαμβάνειν.—Met. iv. 3. Εὐριπίδειόν τι συμβήσεται· ἡ μὲν γὰρ γλῶττα ἀνέλεγκτος ἡμῖν ἔσται, ἡ δὲ φρὴν οὐκ ἀνέλεγκτος.—Theætetus, § 29. It was an artifice of the Sceptics to profess not to see the evidence of the Axiom; then, if a proof of any proposition was adduced, they said, Before we can accept this proof, we must have a criterion of its legitimacy; and before we accept a criterion, we must have a proof of its authority; and the legitimacy of this prior proof must be guaranteed by a prior criterion; and so on *ad infinitum*, (Sextus Empiricus.) As, however, the perception of the Axiom constitutes the reasoning faculty, not to see its evidence would be not to have the faculty of reasoning. Aristotle calls the Sceptics stocks, (ὅμοιος γὰρ φυτῷ ὁ τοιοῦτος.—Met. iv. 3.) the Stoics called them stones, (ἀπολίθωσις γάρ ἐστι τοῦ νοητικοῦ ὅταν τις παρατεταγμένος ᾖ μὴ ἐπινεύειν τοῖς ἐναργέσι.—Arrian, i. 5.) if they could not see the force of the Axiom. It is a mistake to attempt to demonstrate the principle of demonstration. ἀξιοῦσι δὲ καὶ τοῦτο ἀποδεικνύναι τινὲς δι' ἀπαιδευσίαν· ἔστι γὰρ ἀπαιδευσία τὸ μὴ γινώσκειν, τίνων δεῖ ζητεῖν ἀπόδειξιν, καὶ τίνων οὐ δεῖ.—Met. iv. 4.

Hypothesis, unless sensation is Hypothesis; for Hypothesis is a premiss whose existence produces a conclusion. The geometer is not guilty of a false Hypothesis, as some say, when he calls a line straight, or a foot in length, that is not straight nor a foot in length. Not the straightness nor length of this line, but that which it represents, is the ground of his conclusion.

Petition and Hypothesis are either universal or particular; Definition is neither.

CHAPTER XI.

SYLLOGISM DEPENDS ON THE AXIOM OF CONTRADICTION.

§ 1. The existence of Ideas, or unities separable from many, is not indispensable to demonstration; which only requires the existence of classes, or unities predicable of many. Unless one and the same thing is predicable univocally of many, there could be no demonstration, for there could be no commensurate middle.

§ 2. That of two contradictory predicates one must be false, is never expressed in demonstration, but implied in all direct proof.[1] When we syllogize, we assume that the Major is truly affirmed of the Middle, and not truly denied, without caring whether the Middle can be truly denied of the Major. And so with respect to the Middle and Minor. For if we assume that all Man is Animal, and not not-animal; it will be true that Callias is Animal, and not not-animal; even though not-Callias be also Man, and not-man be also Animal. For the conclusion is not impaired though the Major be incommensurate to the Middle, and the Middle incommensurate to the Minor.

§ 3. The principle that one or the other of two contradictories must be true, is assumed in indirect proof; not in its com-

[1] The principle of syllogism, the *dictum de omni et nullo*, is not employed as a premiss: if, however, the conclusiveness of an argument is challenged, the principle may be expressed and compared with the argument proposed. See Post. Anal. ii. 6. *οὐδ' ἐν συλλογισμῷ λαμβάνεται τί ἐστι τὸ συλλελογίσθαι· ἀλλὰ πρὸς τὸν ἀμφισβητοῦντα εἰ συλλελόγισται ἢ· μὴ τοῦτο, ἀπαντᾶν δεῖ, ὅτι· τοῦτο γὰρ ἦν συλλογισμός.*

mensurate form, but so far as it is applicable to a particular matter.

§ 4. The common principles express neither the subject nor the attribute, but are the canons of demonstration; and are the common property of the particular sciences, of Dialectics, and of (Metaphysics,[1] or) whatever science it is which makes a commensurate investigation of these propositions; Of two contradictories one or the other must be true; Equals, from which equals are subtracted, have equal remainders; and the like. Dialectics has no peculiar and definite premisses, nor a single subject-matter, or it would not accept the opponent's propositions.[2] You cannot be indifferent to the concessions, if you wish to demonstrate: for, when treating of syllogism, we showed that opposite premisses will not furnish the same conclusion.

CHAPTER XII.

PECULIARITIES OF SCIENCE.

§ 1. A syllogistic question is the proposition of a necessary alternative, and as propositions are peculiar to each science, a question may be inappropriate to a given science. A geometrician or physiologist may be asked an ungeometrical or unphysiological question. Only the premiss of a Geometrical conclusion, or of a conclusion, like an Optical theorem, that is drawn from Geometrical premisses, is Geometrical: and such a question the geometrician is bound to solve by the principles

[1] Metaphysics is not mentioned in the text, but the investigation of the Axioms is assigned to this science, Met. iv. 3; also Met. xi. 4. ἐπεὶ δὲ ὁ μαθηματικὸς χρῆται τοῖς κοινοῖς ἰδίως, καὶ τὰς τούτων ἀρχὰς ἂν εἴη θεωρῆσαι τῆς πρώτης φιλοσοφίας.

[2] From this and the following chapter it appears that Dialectics has no definite subject-matter: (ἡ δὲ διαλεκτικὴ οὐκ ἔστιν ὡρισμένων τινῶν οὐδὲ γένους ἑνός τινος, chap. xi.)

That it has no appropriate principles: (ἐρώτημα ἐπιστημονικὸν ἐξ ὧν ὁ καθ' ἑκάστην οἰκεῖος γίνεται συλλογισμός, chap. xii.)

That it is not confined to definitions, but employs accidental premisses: (οὐδὲν συμβεβηκὸς λαμβάνουσι τὰ μαθήματα, ἀλλὰ καὶ τούτῳ διαφέρουσι τῶν ἐν τοῖς διαλόγοις, ἀλλ' ὁρισμούς.—Ibid.)

and conclusions of Geometry. As geometrician, he is not bound to answer an opponent who questions the principles of Geometry.[1] The professor of a particular science is not bound to answer all questions indiscriminately, but only those which fall within the province of his science. In controversy with a geometer only conclusions from Geometrical premisses are legitimate; or, if they refute him, they only refute him accidentally, and not as a geometrician. A Geometrical controversy should be conducted before a tribunal of geometers; else an ungeometrical argument will pass without detection: and so in other sciences.

§ 2. If some problems are ungeometrical and do not belong to the geometer, what ignorance is Geometrical, and when does it affect the pretensions of the geometer? and, in general, what kind of ignorance affects our pretensions to any particular science? Is that syllogism which is constructed of premisses contradictory to the true, the [2]Geometrical paralogism, ungeometrical? or rather, the syllogism belonging to an extraneous science—for instance, Music? The answer to this is, that ungeometrical, like unrhythmical, is equivocal; implying either the absence or the badness of Geometrical character. To suppose that parallel lines can meet, is in the first sense Geometrical, in the other ungeometrical. Ignorance founded on principles ungeometrical in the latter sense is inconsistent with pretensions to Geometrical science.

§ 3. In Mathematics, logical fallacies are not so practicable as elsewhere. Two terms, the minor and middle, ought to be distributed; the major may be undistributed. In Mathematics the fulfilment of these conditions is more obvious than in naked argument, as the diagrams submit them to ocular perception. Is every circle a figure? Is a poem a circle? The diagram betrays the equivocation.

The subject of discussion must not itself be brought as

[1] *τῷ γεωμέτρῃ οὐκ ἔτι λόγος ἐστὶ πρὸς τὸν ἀνελόντα τὰς ἀρχὰς, ἀλλ' ἤτοι ἑτέρας ἐπιστήμης ἢ πασῶν κοινῆς.*—Phys. Ausc. i. 2. *ἀπορήσειέ τις ἂν ποίας ἐστὶν ἐπιστήμης τὸ διαπορῆσαι περὶ τῆς τῶν μαθηματικῶν ὕλης . . . . λείπεται τοίνυν τὴν προκειμένην φιλοσοφίαν περὶ αὐτῶν τὴν σκέψιν ποιεῖσθαι.*—Met. ii. 1.

[2] i. e. the Pseudographema.—See Soph. Elench. 11.

enstasis against an inductive proposition: for as a proposition must be general, or it would not be commensurate, so must an enstasis be.[1] For every enstasis is a proposition: every enstasis may become a premiss in dialectical or demonstrative syllogism.

An argument is illogical when the middle is the predicate of both terms it is intended to connect: as Cæneus argues, that fire increases in a geometrical proportion, because both fire and this proportion augment with great rapidity. The conclusion would follow, if fire developed in the most rapidly augmenting proportion, and such proportion were geometrical.

§ 4. Sometimes the premisses, though inconclusive in their original form, may be remodelled so as to furnish a legitimate conclusion. If true conclusions never resulted from false premisses, they would be reciprocally demonstrable, and it would be easy to analyze a theorem into its principles. This reciprocation is more common in Science than in Dialectics, for the premisses of the former are never accidents, but definitions.

§ 5. The demonstrative chain grows by apposition of terms, not by interposition. For instance: A is predicated of B, and B of C, and C of D, *ad infinitum*.[2] Or it takes two directions: if, for example, A is predicated of B and D, and these are respectively predicated of C and E: A representing number finite or infinite: B finite odd number: D finite even number: C a particular odd number: E a particular even number: we have two lines of predication, A, B, C, and A, D, E.

[1] The drift of this is obscure: it may mean: in Geometry the subject of discussion itself is present, and exposes any equivocation: but in Dialectics it is not allowed to adduce the subject of discussion itself as an objection against a proposition, but we must find a similar case that falls under the same universal. See Top. viii. 2. *ἀξιωτέον τὰς ἐνστάσεις μὴ ἐπ' αὐτοῦ τοῦ προτεινομένου φέρειν.*

[2] Synthetical reasoning uses no premisses between whose extremes a middle can be interposed; proof is the interposition of middles between the extremes of a problem. *τῷ γὰρ ἐντὸς ἐμβάλλεσθαι ὅρον ἀλλ' οὐ τῷ προσλαμβάνεσθαι ἀποδείκνυται τὸ ἀποδεικνύμενον*, chap. XXII. *αὔξεται* is used for the deduction of a given conclusion, chap. XIV.

CHAPTER XIII.

FACT AND REASONED FACT.

§ 1. Knowledge of a fact is distinct from knowledge of its reason; and if it belongs to the same science, presents two varieties. Either the premisses from which we conclude are not immediate, and cannot disclose the primary cause; or, though immediate, they do not conclude from the cause, but from its reciprocating and more evident effect: for an effect is often more evident, and supplies a middle term for the demonstration of its reciprocating cause.

§ 2. The proximity of the planets may be proved by the absence of scintillation.[1] Let C represent the planets, B non-

[1] The following examples are taken from Mr. Whewell's Philosophy of the Inductive Sciences. "It is inferred that the earth is a globe, because we find that as we travel to the north, the apparent pole of the heavenly motions, and the constellations which are near it, seem to mount higher, and as we proceed southwards they descend. Again, if we proceed from two different points considerably to the east and west of each other, and travel directly northwards from each, as from the south of Spain to the north of Scotland, and from Greece to Scandinavia, these two north and south lines will be much nearer to each other in their northern than in their southern parts. These and similar facts are seen to be consistent with a convex surface of the earth, and with no other."—Bk. ii. ch. 6.

Here, as the convergence of meridians towards the north, and the visible descent of the north pole of the heavens as we travel south, are made the middle term, and the globular form of the earth the major, the reasoning is analytical or inductive, and the conclusion merely a fact: if the middle and major changed places, the conclusion would be a reasoned fact.

Again, from the risings and settings and eclipses of the moon, it is inferred that she moves in an ellipse, with variable axis and eccentricity; and this is explained by supposing that she is attracted by the earth and sun inversely as the squares of the distance.—See Inductive Table of Astronomy.

The conclusion of the first syllogism is the movement of the moon; of the second, the forces by which this movement is produced; and both are fact-conclusions. If we started from the forces we might deduce the movement, and from the

scintillation, and A proximity. B is true of C, and by induction or sense we know that A is true of B, therefore A is true of C. We have now demonstrated the fact of their proximity, without the reason; for non-scintillation is the effect, not the cause, of proximity. Invert the proof, and you have a demonstration by the reason. Let the middle B represent proximity, and the major A non-scintillation, then the middle, by which we conclude A of C, is the primary cause, and we have a demonstration by the reason. So if, from the moon's waxing and waning, we conclude that her shape is spherical, we prove a fact; if from her sphericity we infer the phænomena of her waxing and waning, we prove by the reason; for her spherical shape causes the phænomena of her waxing and waning.

§ 3. The other case of fact-conclusion occurs when the middle and major do not reciprocate; then, if the effect is more notorious, the fact may be proved without the reason; and when the middle is not intermediate, but exterior to the extremes, as in the second figure, then we can prove the fact, though ignorant of the reason.[1] We do not assign the cause of a wall's non-respiration, when we say it is not an animal; for the animal character is not the cause of respiration. For if a negative is the cause of a predicate's absence, the affirmative is the cause of its presence: if the distemperature of heat and cold is the cause of sickness, then temperature is the cause of health: and if an affirmative is the cause of a predicate's presence, the negative must be the cause of its absence. In the above instance this condition was wanting; the animal character does not involve the presence of respiration. The inference

movement the phænomena, and these would be reasoned conclusions.

Again, the ebb and flow of the tides may be made either a middle term to prove the attraction of the sea by the sun and moon, or a major term to be proved by this attraction.—Ibid.

"The doctrine which is the hypothesis of the deductive reasoning is the inference of the inductive process. The special facts which are the basis of the inductive inference are the conclusion of the train of deduction. And in this manner the deduction establishes the induction. The principle which we gather from the facts is true, because the facts can be derived from it by rigorous demonstration. Induction moves upwards, and deduction downwards, on the same stair."—Book ii. 6.

[1] ἔξω is equivalent to ἀνωτέρω.—See chap. XXIII.

was made in the second figure: All that respires is animal; a wall is not animal; therefore a wall has no respiration. Similar to this are far-fetched reasons, as that of Anacharsis, who said there were no flute-players in Scythia because there were no vines.

§ 4. Within the same science, and with reference to the position of the middle term, the syllogism of fact and the syllogism of reason thus differ. The fact also differs from the reason, as belonging to a different science, having the relation of Optics to Geometry, Mechanics to Stereometry, Harmonics to Arithmetic, Celestial Phænomena to Astronomy. Such sciences are not always distinguished by name: as Mathematical and Nautical Astronomy; Mathematical and Æsthetical Harmonics. The fact belongs to the Æsthetical, the reason to the Mathematical branch. The professor of the latter, though he could give the causal demonstration, is often ignorant of the fact: as we are often ignorant of phænomena, when we know a universal law, if we have not traced it through all its manifestations. This happens when the specific element connected with an attribute, and whose connexion is expressed in the law, is mixed in the phænomenon with a mass of other elements: for Mathematics separate the element they examine; which, though insulated in the science, perhaps never exists in nature except in combination.[1] As Geometry is related to Optics, so are Optics to the theory

[1] On the subject-matter of Mathematics see Metaph. xiii. 3; Post. Anal. i. 18. The following is a division of the sciences: ἡ ἅπασα διάνοια ἢ Πρακτικὴ ἢ Ποιητικὴ ἢ Θεωρητικὴ .... εἰ δέ τι ἐστὶν ἀκίνητον καὶ αἴδιον καὶ χωριστὸν, φανερὸν ὅτι Θεωρητικῆς τὸ γνῶναι· οὐ μέντοι Φυσικῆς γε, περὶ κινητῶν γάρ τινων ἡ Φυσικὴ, οὐδὲ Μαθηματικῆς, ἀλλὰ προτέρας ἀμφοῖν. Ἡ μὲν γὰρ Φυσικὴ περὶ ἀχώριστα μὲν, ἀλλ' οὐκ ἀκίνητα· τῆς δὲ Μαθηματικῆς ἔνια περὶ ἀκίνητα μὲν, οὐ χωριστὰ δὲ ἴσως, ἀλλ' ὡς ἐν ὕλῃ· ἡ δὲ Πρώτη καὶ περὶ χωριστὰ καὶ ἀκίνητα· ὥστε τρεῖς ἂν εἶεν Φιλοσοφίαι θεωρητικαὶ, Μαθηματικὴ, Φυσικὴ, Θεολογική· οὐ γὰρ ἄδηλον ὅτι, εἴ που τὸ Θεῖον ὑπάρχει, ἐν τῇ τοιαύτῃ φύσει ὑπάρχει· καὶ τὴν τιμιωτάτην δεῖ περὶ τὸ τιμιώτατον γένος εἶναι.—Met. vi. 8. See also Met. xi. 3, 4, and 7. ἡ δὲ Μαθηματικὴ θεωρητικὴ μὲν καὶ περὶ μένοντά τις αὕτη, ἀλλ' οὐ χωριστά· εἰ δ' ὑπάρχει τις οὐσία χωριστὴ καὶ ἀκίνητος, ὅπερ πειρασόμεθα δεικνύναι, ἐνταῦθα ἂν εἴη που καὶ τὸ θεῖον. δῆλον τοίνυν ὅτι τρία γένη τῶν θεωρητικῶν ἐπιστημῶν ἐστι, Φυσικὴ, Μαθηματικὴ, Θεολογική.

of the Rainbow. The explanation strictly belongs to Optics: the facts to Physical science. Many sciences not subordinate are in particular points thus related. The fact, that circular wounds are slow to heal, belongs to the Physician; the explanation to the Geometer.

CHAPTER XIV.

THE FIRST FIGURE IS MOST SCIENTIFIC.

§ 1. Of all the figures the first is most employed in science. It is employed by all the mathematical sciences, Arithmetic, Geometry, Optics, for instance: and a reasoned conclusion, the most characteristic point of science, is generally if not universally drawn in this figure.

Secondly, it is the only one adapted for establishing a definition, which is universal and affirmative, the conclusions of the second and third being negative and particular.

Thirdly, the intercalation of more and more elementary laws, and finally of the immediate, by which the premisses of the latter figures are deduced, must take place in the first figure.[1] The first is self-sufficient, and appears on these accounts to play the chief part in science.

[1] Deduction is called condensation, (*καταπυκνοῦται,*) because it consists of the interposition of middle terms. The proposition, all A is E, is thus deduced:—

All C is E.
All A is C.
.·. All A is E.

Both of these premisses may be thus deduced:—

All D is E.
All C is D.
.·. All C is E.

And

All B is C.
All A is B.
.·. All A is C.

The deduction is complete when all the premisses, A B, B C, C D, D E, are immediate propositions.

ἀεὶ τὸ μέσον πυκνοῦται ἕως ἀδιαίρετα γένηται καὶ ἕν, chap. XXIII.

CHAPTER XV.

NEGATIVE PROPOSITIONS MAY BE INDEMONSTRABLE.

The proposition, B is not A, as well as the proposition, B is A, may be an atomic truth. A proposition is an atom or indivisible, whose terms are divided by no intermediate link, and connected or disconnected by no foreign cause.

If either A, or B, or both, have a genus, the disjunction of A and B cannot be primary. For, if C is the genus of A, it perhaps is not the genus of B: then, because A is C, and B is not C, we may infer that B is not A. Or if D were a genus of B, so that all B were D, and no D were A, we might infer that no B is A. And similarly, if both B and A have a genus. The possibility that the genus of A should not be a genus of B, or the genus of B not a genus of A, is clear from the contra-distinguished categories or orders. If nothing in the category A, C, D, is predicable of any thing in the category B, E, F, and G in the first group is genus of A, it cannot be genus of B, or the groups would not be mutually exclusive; and similarly if B had a genus.

If neither has a genus, and B is not A, the proposition is an atomic negative. Were there a middle term and proof, one of them must have a genus: for the proof must fall into the first or second figure. If in the first, B has the genus, for the minor premiss of this figure must be affirmative: if in the second, one or the other must have the genus, for either premiss may be negative, but not both.

Under these conditions a negative proposition may be indivisible or atomic.

CHAPTER XVI.

ERROR IN PRINCIPLE.

§ 1. Ignorance, that is not merely the negative but the contrary of knowledge, is either direct or concluded; and either of mediate or of immediate propositions. Ignorance of immediate or primary propositions, whether affirmative or negative, if a direct belief, admits of no varieties: if a concluded error, it may arise under several conditions.

§ 2. Let the proposition, no B is A, be an indivisible or atomic truth. If you conclude that all B is A, by a middle term C, you are deceived by deduction: and either both, or only one of your premisses,

all C is A
all B is C,

may be false. Both may be false: for it is possible that the statement, all C is A, is false; and, as the proposition, no B is A, is primary, and B can therefore have no genus, the statement, all B is C, is also false.

Or one of the premisses may be true: but this can only be the major, all C is A. The minor, all B is C, must be false; for, if the proposition, no B is A, is primary, B can have no genus. The major, all C is A, may be true; for the propositions,[1]

all C is A
no B is A,

whether mediate or immediate, are quite consistent with the proposition, no B is C.

§ 3. This is the only manner in which we can conclude a false affirmative, for only the first figure concludes an affirmative universal. A false negative may be drawn either in the first or

[1] This passage and another in the following chapter (ἐγχωρεῖ γὰρ τὸ Α πλείοσιν ὑπάρχειν ἃ οὐκ ἔστιν ὑπάλληλα) are the only places where κατηγορεῖσθαι and ὑπάρχειν are used generically of affirmative and negative propositions.

in the second figure. Let us examine under how many conditions a false conclusion, no B is A, may be drawn in the first figure.

Both the premisses,

no C is A
all B is C,

may be false: for the assumption, that all C is A, and no B is C, does not contravene the hypothesis, that all B is A.

Or one or the other indiscriminately may be false: The major, no C is A, may be true; and then the minor, all B is C, must be false: for, firstly, the propositions,

all B is A
all B is C,

would give the conclusion, some C is A, which contradicts the major we have just assumed to be true; and, secondly, the premisses,

no C is A
all B is C,

give the conclusion, no B is A, which contradicts the hypothesis.

Or the minor, all B is C, may be true; and then the major, no C is A, must be false: for, from the hypothesis and minor,

all B is A
all B is C,

it follows that some C is A, and therefore the major, no C is A, is false.

In the first figure, then, a false conclusion may proceed from either one or two false premisses.

§ 4. If the false conclusion, no B is A, is drawn in the second figure, the premisses cannot both be wholly false or contrary to the truth. If all B is A, no middle term can be universally affirmed of one extreme, and universally denied of the other: for the false conclusion, no B is A, must result from such premisses. But they cannot both be contrary to the truth; for then the contraries of both ought to be true propositions; but we should again have a middle term universally denied of one extreme, and universally affirmed of the other.

§ 5. Both premisses may be partly false or contradictory to the truth. Whether the premisses are, all A is C, and no B is

C; or, no A is C, and no B is C; we may suppose them both contradictory to the truth, without contravening the hypothesis, all B is A.

§ 6. Either premiss singly may be contrary to the truth.

Let the premisses be,

all A is C
no B is C;

then, if the major is true, we have the true propositions,

all A is C
all B is A;

so that the minor,

no B is C,

is contrary to the truth.

Or, if the minor is true, we have the premisses,

no B is C
all B is A;

from which it follows that some A is not C; and therefore the major, all A is C, is contradictory to the truth, and may be contrary.

Or, let the premisses be,

no A is C
all B is C;

then, if the major is true, we have the propositions,

no A is C
all B is A;

from which it follows that the minor, all B is C, is contrary to the truth.

Or, if the minor is true, then we have the propositions,

all B is C
all B is A,

which give the conclusion, some A is C: therefore the major, no A is C, is contradictory to the truth, and may be contrary.

An atomic or elementary error may therefore result from one or from two erroneous premisses.

CHAPTER XVII.

ORIGIN OF ERROR IN DEMONSTRABLE PROPOSITIONS.

§ 1. With respect to mediate or deducible propositions, affirmative or negative, if the middle by which they are falsely concluded is appropriate, both premisses cannot be false, but only the major. The appropriate middle is that by which the truth might be concluded. Let the true conclusion, all B is A, be deducible from the middle C. The minor premiss must always be affirmative and true; if it were negative, there would be no conclusion: but the major may be false, for, converted into its contrary, it gives a contrary conclusion.[1]

§ 2. When the true premisses are,

all D is A
all B is D;

where the middle D is inappropriate, and taken from a distinct category; we leave a conclusion if we change the quality of the major, but not if we change the quality of the minor: so that the one must always be true, the other always false: and this case resembles that of the appropriate middle.

§ 3. Supposing the true premisses to be,

all D is A
no B is D,

both premisses of our deduction must be false: for we must change the quality of both in order to make a syllogism: we must assume,

no D is A
all B is D;

both which propositions are false.

[1] ἀντιστροφή here means change of quality; in Prior. Anal. ii. 8, it signifies the substitution of the conclusion for one of the premisses.

§ 4. In this last syllogism, if the major is true, the minor must be false; for it leads to the conclusion, no B is A, which is false by hypothesis.

§ 5. When the erroneous conclusion is in the second figure, both premisses cannot be wholly false or contrary to the truth: for, as we observed before, when all B is A, no middle can be universally affirmed of the one extreme, and universally denied of the other; but either singly may be contrary to the truth. If the true propositions are

all A is C
all B is C;

and we assume the premisses,

all A is C
no B is C;

the major premiss is true, and the minor false: if we assume the premisses,

all B is C
no A is C:

the minor is true, and the major false.

When the conclusion is negative, these are the sources of error.

§ 6. When the conclusion is affirmative, and drawn from the appropriate middle, both premisses cannot be false, for the minor must be affirmative to give any conclusion; so that the error must be in the major: for this is the only premiss whose contrary affords a conclusion.

§ 7. Similarly, if the middle be inappropriate and heterogeneous, as we observed in the case of the negative conclusion, the minor cannot be converted into its contrary, but the major can: and the deception is the same as when the middle is appropriate and homogeneous.

§ 8. When all D, the inappropriate middle, is A, our major premiss, all D is A, is true, and the minor, all B is D, is false. For it does not follow from the propositions,

all D is A
no B is A,

that all B is D.

§ 9. If no D is A, our major premiss, being affirmative, is false; while the minor, all B is D, may be either true or false. While no B is A, it may be true that no D is A, and all B is D: for example; music is a science, and neither music nor science is an animal: or, it may be true that no D is A, and no B is D.

If, then the major premiss is negative, one or both the premisses may be false.

We have seen in how many ways it is possible to be misled either in demonstrable or in indemonstrable propositions.

CHAPTER XVIII.

NEGATIVE IGNORANCE.

If man has lost any sense, he has lost a corresponding science, now unattainable. We acquire knowledge by induction or demonstration, the one based on phænomena, the other on laws, which are only discoverable by induction.

Even the materials of mathematics are furnished by induction;[1] which shews us throughout nature certain attributes, which, though not self-existent and substantive, are insulable in thought. The cognizance of phænomena belongs to sense, not to reason. Sense, then, is indispensable to induction, and induction to discovery of the law.

CHAPTER XIX.

ARE ANY TRUTHS IN THEIR OWN NATURE INDEMONSTRABLE?

§ 1. All deduction involves three terms, and either connects a predicate A with a subject C, by predicating A of B, and B of

[1] ὁ μαθηματικὸς περὶ τὰ ἐξ ἀφαιρέσεως τὴν θεωρίαν ποιεῖται· περιελὼν γὰρ πάντα τὰ αἰσθητὰ θεωρεῖ, οἷον βάρος καὶ κουφότητα καὶ σκληρότητα καὶ τοὐναντίον, ἔτι δὲ καὶ θερμότητα καὶ ψυχρότητα καὶ τὰς ἄλλας αἰσθητὰς ἐναντιώσεις· μόνον δὲ καταλείπει τὸ ποσὸν καὶ συνεχὲς, τῶν μὲν ἐφ' ἓν τῶν δ' ἐπὶ δύο τῶν δ' ἐπὶ τρία, καὶ τὰ πάθη τὰ τούτων, ᾗ ποσά ἐστι καὶ συνεχῆ καὶ οὐ καθ' ἕτερόν τι, θεωρεῖ.—Met. xi. 3.

C; or disconnects them by ascribing a predicate to the one and withholding it from the other. Such statements are the elements and hypotheses of deduction. We conclude that A is predicated of C by the middle B; and that A is predicated of B by some other middle; and that B is predicated of C by another. Dialectics only aiming at belief, credibility, as far as circumstances allow, is the only requisite of its premisses. If a middle term between A and B is credible, though not real, it is sufficient for dialectical proof, but not for science.

When we predicate whiteness of man, the predication is essential: whiteness is not ascribed to man, because man is ascribed to any other substance.[1] When we predicate man of whiteness, the predication is accidental: man is ascribed to the whiteness, because the whiteness is ascribed to a man.

§ 2. Let C be the attribute of no subject, but the primary subject of B, without any intermediate; and let B be the primary subject of F, and F the primary subject of E: must such a series terminate, or is it illimitable?

§ 3. Again, if there is no essential predicate of A, and A is a primary predicate of H, with no antecedent intermediate; and H of G, and G of B; must such a series terminate, or may this too be illimitable?

This question differs from the former: the former asked, if we begin from a primary subject, can we go upwards along an illimitable series? The second, if we begin from a primary predicate, can we go downwards along an illimitable series?

§ 4. Again, if the extremes are fixed, can the intermediate links be infinite? When B is intermediate between A and C, and others between A and B, and others between these; can this intercalation be endless? This is to ask, is there any end to demonstration? is everything demonstrable, or are the connecting intermediates finite?

§ 5. The same question arises in negative syllogisms and propositions. When no B is A, A is either denied primarily of

[1] This kind of essential or proper predication, which occurs again at the beginning of chap. XXII. must not be confounded with the essential predication mentioned in chap. IV. and at the end of chap. XXII. which is characteristic of science, and is only one species of proper predication.

B; or antecedently of some other term G, which is predicated of all B; and either primarily of G, or antecedently of some other term H. There is either an endless series of terms of which A is antecedently denied, or there is a primary term that ends the series.

§ 6. In a reciprocating series there can be no primary nor ultimate term; for there is no antecedence nor subsequence, even though both the ascending and the descending series are limitless; their reciprocation, however, may be dissimilar, giving sometimes an essential, and sometimes an accidental predicate.

CHAPTER XX.

INTERMEDIATES OF GIVEN EXTREMES ARE FINITE.

§ 1. If the series of ascending or more universal predicates, and descending or more particular subjects, is limited in both directions, the number of intermediates must be finite. If the terms interposed between the extremes of the proposition, F is A, were innumerable, we might start from F, and travel up an endless succession of predicates without reaching A; or start from A, and travel down an endless succession of subjects, without reaching F. This by hypothesis is impossible: the intervening links between F and A are therefore finite.

§ 2. It is equally impossible that some should touch and be undivided, and others severed by an impassable chasm. Select any intervening term whatever, and the number of intermediates that divide it from A and F must either be finite or infinite. Where the chasm occurs is immaterial. The hypothesis is violated, if any term is severed by an infinite series from either extreme.

CHAPTER XXI.

NEGATIVE PROPOSITIONS.

§ 1. If the retrogression of subjects and progression of predicates is limited in the analysis of affirmative propositions, it must be so in the analysis of negative.

Let us examine the proof of a negative conclusion in the three figures; and assume that, in affirmative propositions, we cannot progress from a primary subject, nor retrogress from an ultimate predicate, without arriving at a limit.

§ 2. If we prove the negative, no C is A, in the first figure, by the premisses,

no B is A
all C is B,

the number of intercalated terms in the minor interval or proposition, C is B, is by hypothesis finite; for this interval is always affirmative. The major may be proved by the antecedent premisses,

no D is A
all B is D;

and this major by the antecedent premisses,

no E is A
all D is E:

so that every antecedent proof adds a higher predicate of C; and,[1] as their progression is by hypothesis limited, the subjects of A must be also limited; and there must be some term of which A is primarily denied.

§ 3. In the second figure, if we prove the conclusion, no C is A, by the premisses,

all A is B
no C is B,

the minor premiss may either be proved in the first or in the second figure: let us prove it in the second; and we require the premisses,

all B is D
no C is D:

[1] ὥστ' ἐπεὶ ἡ ἐπὶ τὸ ἄνω ἵσταται ὁδὸς, καὶ ἡ ἐπὶ τὸ κάτω στήσεται. ἡ ἐπὶ τὸ ἄνω ὁδός is the line of terms from B up to A; ἡ ἐπὶ τὸ κάτω is the line from A down to B. In the Tauchnitz edition the ἄνω and κάτω are transposed.

if we again prove the minor, we require the premisses,

all D is E
no C is E:

so that every antecedent proof adds a higher predicate of A; and, if these are limited, the antecedent negatives are also limited.[1]

§ 4. In the third figure, if we prove the conclusion, some C is not A, by the premisses,

some B is not C .
all B is A:

the major premiss may either be proved in the former figures, in which we saw the progression was limited; or, if we prove it in the third, we require the premisses,

some D is not C
all D is B:

and to prove this major, we require the premisses,

some E is not C
all E is D:

so that every antecedent proof adds a lower subject of A; and therefore, as the retrogression of affirmative subjects is assumed to be limited, the retrogression of negative subjects is also limited.

§ 5. As, then, the number of proofs in each figure is limited, and the number of figures is limited; and as the product of two finite numbers is finite; the number of antecedent nega-

[1] The syllogisms examined are in Camestres; if we examine them in Cesare, the result is slightly different. We may prove the negative, no C is A, by the premisses,

no A is B
all C is B,

the major may be proved by the premisses,

no B is D
all A is D;

and this major by the premisses,

no D is E
all B is E.

From which it appears that the deduction in Cesare does not always add a higher predicate of the major term, as in Camestres, but alternately a higher predicate of the minor and major.

tives will be finite, even though the conclusion should be drawn in every figure.

If, then, the succession of subjects and predicates is limited in the analysis of an affirmative proposition, it is limited in the analysis of a negative.

CHAPTER XXII.

THE TRAINS OF PREDICATION ARE FINITE.

§ 1. First let us give a dialectical proof.

Predicates that compose the essential character must be finite: else, as infinite elements could not be enumerated, such character would be indefinable.

Before we can complete this proof we must make some preliminary remarks.

§ 2. Predication is essential or proper, when I affirm that wood is white, or that a man walks. Wood is the subject of whiteness: whiteness is an attribute possessed by wood or a species of wood, not by another subject to which wood is also ascribed.

Predication is accidental or improper, when I affirm that the white is wood, or that the white is musical. White is not the subject of wood, wood is not an attribute ascribed to white or to a species of white, but is a subject to which the attribute whiteness is ascribed.

When I affirm that the white is musical, white is not the subject of musical; musical is not an attribute ascribed to white nor to a species of white, but to man, a subject to which the attribute whiteness is also ascribed.

§ 3. The predicates that enter demonstration are proper, not accidental, and fall under the categories of substance, quality, quantity, relation, action, passion, place, or time.

When substance is predicated, the subject is either the predicate or a species of the predicate, as when animal is predicated of man.

When accident is predicated, it is neither identical with the subject, nor its genus: as white is predicated of man.

No accident can exist but by inherence in a substance. The Platonic Ideas are imaginary, and, even if they existed, would

be nothing to our purpose, not being concerned in demonstration.

§ 4. If A is a quality of B, B cannot be a quality of A, and they cannot precipitate with absolute predication.

Such predication cannot be circular or reciprocal. If the terms reciprocate as genera; firstly, no essence would be definable, for we could not exhaust an infinite series of genera; secondly, a genus would be a species of itself.

If the terms reciprocate as substance and accident, their predication is only accidental.

§ 5. Rectilinear predication cannot proceed without a limit.[1] For the predicates are either substantive genera, and this series we know to be finite; or they are accidents, essential or unessential. Every accident inheres in some term of the substantive succession: their descending or subject series, therefore, is limited by the limit of this succession: and, as their genera are finite like those of substance, their ascending or predicate series is also limited. The scale, therefore, has both a basis or primary subject, and an apex or ultimate predicate.

§ 6. Another dialectical proof is as follows: antecedent predicates make a proposition demonstrable; and the demonstrable cannot be apprehended better than by knowledge, and cannot be known without demonstration. If the antecedents are neither known nor apprehended better than if they were known, the consequents cannot be the objects of knowledge. The number therefore of intermediate predicates must be limited, if demonstration is categorical, and not merely hypothetical. If the succession of higher predicates is unlimited, every truth is demonstrable, but, as an endless preceding series has to be passed, cannot be demonstrated; and, as we do not apprehend them with any thing better than knowledge, our science is not categorical, but merely hypothetical.

§ 7. These proofs are dialectical:[2] a scientific and shorter

[1] ἀλλὰ δὴ οὐδ' εἰς τὸ ἄνω ἄπειρα ἔσται. As this chapter, though one of the most important in the treatise, as asserting the Logical Hypothesis, the existence of first truths, is also one of the most carelessly written and most obscure, somewhat more liberty has been taken in departing from the letter of the original than elsewhere.

[2] The first proof appears to be Dialectical, because it applies to

proof that the series of essential predicates (which demonstrative science alone regards) must terminate in both directions, is as follows:—A predicate is essential if it enters into the definition of the subject, as divided into the definition of number: or if the subject enters into the definition of the predicate, as number into the definition of odd.

§ 8. A succession of this latter kind of predicates must be finite: for if there be a further predicate of odd, into whose definition odd enters, number will be the primary subject in the definition of that further predicate, and a limit of its descending series. The terms of the ascending series must be finite, for the whole nexus of properties must inhere in the original subject, and the whole nexus of subjects, which is of equal length, must enter the definition of the ultimate property: and as no predicate can have an infinite line of such subjects, nor any subject an infinite line of such predicates, the ascending series must also eventually terminate.

§ 9. A succession of the former kind of predicates, found in the d finition of the subject, must be finite: else the subject would be indefinable: so that here too the ascending, and consequently the descending, series is finite.

§ 10. If so, two extremes can only have a finite number of intermediates,[1] and demonstration has an absolute basis and

contingent predicates, as well as to essential or necessary, and it leaves us in doubt whether the second kind of essential predicates, whose definition includes their subject, may not extend in a lateral direction without limit; so that the proof is both too extensive and too narrow.

The second proof is merely Hypothetical; there must be first truths if there is science. This is a *petitio principii;* for the object of proving the existence of first truths is to prove the possibility of science; the latter, therefore, must not be assumed as a proof of the former.

The third proof is Analytical, that is, Scientific, (for the present treatise belongs to Analytical Science, or Logic,) because it rests on appropriate principles, the definition of essential propositions.

It is, however, not so much a proof, as a more accurate determination of the principle that must be postulated. This postulate, the existence of first principles, as concerning the constitution of the world, appears to belong properly to Metaphysics, and is merely borrowed by Logic.—See Metaph. ii. 2, and Introduction.

[1] Compare: "Derivative laws are such as are deducible from, and may be resolved into, other and more general ones. Ultimate laws are those

point of departure; and they were mistaken who, we said, denied the existence of indemonstrable truths. If demonstration has an absolute point of departure, all truths are not demonstrable, and the chain of deduction is not endless: otherwise there would be no atomic and irreducible law, but every law would be capable of resolution. Deduction does not add a term, but interpose it between the extremes: and if deduction were endless, two extremes would be sundered by an infinite number of intermediates; which, as we have shown by both dialectical and logical proof, cannot be, as both the ascending and descending series of predication are determinate and bounded.

CHAPTER XXIII.

ULTIMATE LAWS.

§ 1. It follows, that if two terms, neither of which is universally predicable of the other, possess the same predicate, they need not possess it in virtue of a common intermediate. The isosceles and scalene triangles both contain angles equal to two right angles, and in virtue of a common character: but the case is not always similar. If a predicate A is connected with the subjects C and D by the intermediation of B, B will require another intermediate, and this another; and the terms separating the extremes will be infinite. This we have shown cannot be; and we need not always look for a common link to connect a predicate with several subjects, if we recognize the existence of immediate laws. If, however, the predicate is essential, the subjects must be homogeneous, and comprise the same individuals; for we have seen that one and the same demonstrative attribute cannot attach to the matters of heterogeneous sciences.

§ 2. If the proposition, B is A, has an intermediate, it is demonstrable; and the elements of its deduction will equal in

which cannot. We are not sure that any of the uniformities which we are yet acquainted with are ultimate laws; but we know that there must be ultimate laws, and that every resolution of a derivative law into more general laws, brings us nearer to them."—Mill, System of Logic, iii. 14.

number the intermediates, being composed of the immediate laws, or such of them as are universal. Immediate and primary laws are incapable of deduction, and require a different method of discovery.[1] The deduction of negative theorems also depends on the existence of antecedent negations: and the antecedent intermediate laws compose the elementary principles of their deduction; so that primary and indemonstrable truths will be negative as well as affirmative.

§ 3. We demonstrate that A attaches to B, by showing that A attaches to C, and C to B: and thus we never introduce a class higher than A; but continually condense the middle terms,[2] till the theorem is resolved into its indivisible laws, or the units of truth.[3] An unit of truth is an immediate law, for such is absolutely One.

[1] The inductive method.

[2] *καταπυκνοῦται καὶ αὔξεται ἕως ἂν εἰς τὰ ἄμεσα ἔλθῃ.*—Chap. 14.

[3] *τὸ ἑνὶ εἶναι τὸ μέτρῳ εἶναι πρώτῳ ἑκάστου γένους . . καὶ λέγεται μέτρον, ᾧ πρώτῳ ἕκαστον γινώσκεται· . . ἐν πᾶσι δὴ τούτοις μέτρον καὶ ἀρχὴ ἕν τι καὶ ἀδιαίρετον· ἐπεὶ καὶ ἐν ταῖς γραμμαῖς χρῶνται ὡς ἀτόμῳ τῇ ποδιαίᾳ . . . ἀεὶ δὲ συγγενὲς τὸ μέτρον· μεγεθῶν μὲν γὰρ μέγεθος, καὶ καθ' ἕκαστον, μήκους μῆκος, πλάτους πλάτος, φωνῶν φωνὴ, βάρους βάρος, μονάδων μονάς.*—Met. x. 1.

ᾧ γὰρ πρώτῳ γνωρίζομεν τοῦτο πρῶτον μέτρον ἑκάστου γένους. ἀρχὴ οὖν τοῦ γνωριστοῦ περὶ ἕκαστον γένος τὸ ἕν.—Met. v. 6.

καὶ ἐν παντί ἐστί τι ἕτερον ὑποκείμενον· οἷον ἐν ἁρμονίᾳ δίεσις, ἐν δὲ μεγέθει δάκτυλος ἢ πούς, ἐν δὲ ῥυθμοῖς βάσις ἢ συλλαβὴ, καὶ ἐν βάρει σταθμός τις ὡρισμένος.— Metaph. xiv. 1.

Measure was the word used by the older Greeks for what was afterwards called the Criterion. The final Criterion or Measure of truth, according to Aristotle, are the immediate propositions, the elementary perceptions of reason. The Measure of truth may be illustrated by comparison with analogous Measures.

It must be homogeneous to the objects measured: the measuring unit of dimension, weight, sound, colour, will be a dimension, weight, sound, or colour; and as objects measured differ in kind, so will the measuring units. In like manner the measuring units of science, the first principles, must be homogeneous to the conclusions, (Post. Anal. book i. 7, 9, 27, 32,) and will vary in different sciences. This was urged against the Platonists, who overrated the universality of first principles.

The knowledge of the object measured, length for instance, is indirect, by calculation, or reference to the standard unit of length: the knowledge of the unit is direct apprehension by Sense or Imagination. So the knowledge of scientific conclusions differs from the knowledge

The beginning or basis of a system is simple and uncombined, and varies in different systems: in a system of weights the unit is a mina; in musical sounds the unit is a semitone; in demonstration the unit is an immediate law: in science and deductive thought the unit is reason.

Affirmative deduction, as we said, assumes no class higher than the predicate.

§ 4. A negative syllogism in the first figure assumes no term higher than the predicate. The conclusion, no B is A, is proved by the premisses,

no C is A
all B is C:

and this major premiss, no C is A, by the antecedent premisses,

no D is A
all C is D:

so that we never introduce a class higher than A.

§ 5. In the second figure we prove the conclusion, no E is D, by the premisses,

all D is C
no E is C:

or the conclusion, some E is not D, by the premisses,

all D is C
some E is not C:

so that the classes we introduce, though higher than D the major, are not higher than E the minor.[1]

§ 6. In the third figure we prove that some C is not A, by the premisses,

some B is not A
all B is C:

so that the middle introduced is lower both than minor and than major.

of principles: the former is Inference, the latter Reason or immediate intuition. The existence of these measuring units in the mind and in nature is the hypothesis to which we are driven by the idea of Deductive Science.

[1] The syllogisms examined are in Camestres and Baroko: in Cesare and Festino the middle term is higher than the minor, but not higher than the major.

CHAPTER XXIV.

COMPARISON OF PARTICULAR AND COMMENSURATE PROOF.

§ 1. Proofs are commensurate or particular, affirmative or negative, direct or indirect; and their comparative merits are disputed. Let us compare first commensurate and particular.

§ 2. Particular proof may seem to be preferable as conveying greater knowledge: for knowledge is the end and aim of proof; and our knowledge of a subject is greater when we know its attributes as essential, than when we know them as accidental. Our knowledge of the musician Coriscus is greater when we know that Coriscus is a musician, than when we know that a man is a musician. Commensurate proof connects the attribute essentially with a second subject, with the original only accidentally: it does not attach the attribute of containing angles equal to two right angles to the essence of isosceles, but represents it as accidental. If essential proof deserves the preference; as particular proof connects the subject essentially with the predicate, particular proof is preferable.

§ 3. Secondly, whereas commensurate proof treats of unrealities, and inspires us with an opinion of their reality; leading us to believe in the existence of a triangle, figure, and number, distinct from individual triangles, figures, and numbers; and in the definition of proportional, asserting that it transcends and is distinct from number, line, surface, and solid; particular proof, being neither about unrealities nor delusory, is preferable to commensurate.

§ 4. It may be answered, that the first consideration is rather in favour of commensurate proof than of particular. If we prove of isosceles an attribute essential to triangle, the predicate is accidental. If the attribute of containing angles equal to two right angles is demonstrable of triangle, it is essential to triangle and accidental to isosceles. If triangle is a higher class, and univocal, and universally possessed of the attribute, it, and not isosceles, is essentially connected with the attribute.

Commensurate proof, then, as engaged with essential predicates, is preferable to particular.

§ 5. If the commensurate is univocal, it has more of reality than some particulars, they being perishable, while it is imperishable: and its unity does not compel us to believe its separate existence, any more than the separate existence of quality or quantity, or action or passion. If we believe it, we are to blame, and not the commensurate.

§ 6. A demonstration is a proof exhibiting the attribute's cause and reason: the cause is only exhibited by commensurate proof: for the commensurate subject is primary, and the primary is essential, and the essence of the essential subject is the attribute's cause. Commensurate proof, therefore, is preferable, as exhibiting the attribute's cause and reason.

§ 7. Our inquiry into the cause of a change or state does not cease, and we do not consider it known, till no ulterior cause is assignable: the explanation is not finished and complete till it proceeds from the ultimate cause. What was A's motive in his departure? The receipt of money. What was his motive in this? The payment of his debt. What was his motive in this? The performance of his duty to his neighbour. When no ulterior motive is assignable, the last motive is called the final cause of a state or change;[1] and when we know this, we know the reason of an action. This is no peculiarity of the final cause:

[1] An instance of reasoning from the final cause, such as takes place in art and practical deliberation, is given, Metaph. vii. 7.

ἀπὸ τέχνης δὲ γίγνεται ὧν τὸ εἶδος ἐν τῇ ψυχῇ. γίνεται γὰρ τὸ ὑγιὲς νοήσαντος, ἐπειδὴ τόδε ὑγίεια, ἀνάγκη, εἰ ὑγιὲς ἔσται, τοδὶ ὑπάρξαι, οἷον ὁμαλότητα· εἰ δὲ τοῦτο, θερμότητα· καὶ οὕτως ἀεὶ νοεῖ, ἕως ἂν ἀγάγῃ εἰς τοῦτο ὁ αὐτὸς δύναται ἔσχατον ποιεῖν.

And again: *εἰ ὑγιανθήσεται δεῖ ὁμαλυνθῆναι· τί οὖν ἐστι τὸ ὁμαλυνθῆναι; τοδί· τοῦτο δ' ἔσται εἰ θερμανθήσεται. τοῦτο δὲ τί ἐστι; τοδί· ὑπάρχει δὲ τοδὶ δυνάμει· τοῦτο δὲ ἤδη ἐπ' αὐτῷ.*

Compare: *οἱ γὰρ συλλογισμοὶ τῶν πρακτῶ νἀρχὴν ἔχοντές εἰσιν, ἐπειδὴ τοιόνδε τὸ τέλος*, &c.—Nic. Eth. vi. 12.

Resolve, as well as Science, implies a conception of ultimate reasons. *οὐκ ἔστι πάντως ἔχοντος ἀνθρώπου ἡ προαίρεσις, οὐδὲ γὰρ βουλεύσασθαι οὐδ' ὑπόληψις τοῦ διατί. ἔστι γὰρ βουλευτικὸν τῆς ψυχῆς τὸ θεωρητικὸν αἰτίας τινός· τὸ γὰρ οὗ ἕνεκα μία τῶν αἰτίων ἐστί . . . διὸ οἷς μηθεὶς κεῖται σκοπὸς οὐ βουλευτικοί.*—Ethic. Eudem. ii. 10.

and as our knowledge of the motive is incomplete till no ulterior motive is assignable, so, in general, our knowledge of a cause is incomplete till no ulterior intermediate can be assigned. A given figure's exterior angles are equal to four right angles. Why? Because it is an isosceles. Why has an isosceles this property? Because it is a triangle. Why has a triangle? Because it is a rectilinear figure. If this reason is ultimate, it completes our knowledge. This ultimate explanation, which alone is adequate, is commensurate.

§ 8. Objects are knowable so far as they are determinate, and unknowable so far as they are indeterminate: now particular objects are infinite, while commensurate are simple and determinate, being the limits and determinations of the infinite. If then knowledge is greater, the more knowable its correlative objects, commensurate proof, as surpassing its rival in degree of knowledge and demonstrativeness, claims our preference.

§ 9. A proof of two propositions is better than the proof of one: commensurate proof, therefore, is better than particular: for the commensurate conclusion includes the particular, but the particular conclusion does not include the commensurate.

§ 10. In proportion as a proof is commensurate, the premiss approaches to an elementary law:[1] when we have reached the immediate premiss we have reached the elementary law. Deduction is perfect when it commences from the primary law: in proportion, therefore, as our premisses approach the primary law, our deduction approaches perfection. If the proposition,

[1] "It is of importance to remark that when a sequence of phænomena is thus resolved into other laws, they are always laws more general than itself. The law that A is followed by C is less general than either of the laws which connect B with C and A with B .... Not only are the laws of more immediate sequence into which the law of a remote sequence is resolved laws of greater generality than that law is, but (as a consequence of, or rather as implied in, their greater generality) they are more to be relied on; there are fewer chances of their being ultimately found not to be universally true .... They are more nearly unconditional; they are defeated by fewer contingencies; they are a nearer approach to the universal truth of nature .... There needs no more to show how much more general the elementary laws must be, than any of the complex laws which are derived from them."—System of Logic, by J. S. Mill, book ii. 12.

D is A, has the intermediates C and B; if B is a higher class than C, commensurate deduction will begin with B.

§ 11. Some of the above proofs are dialectical. The doctrine is clear, if we consider that a man who knows the commensurate virtually knows the particular. He who knows that every triangle contains angles equal to two right angles, though ignorant that the isosceles is a triangle, virtually knows the predicate of the isosceles. But if he knows the particular conclusion, he neither actually nor virtually knows the commensurate.

Again, the particular is an object of sense, the commensurate of reason.

CHAPTER XXV.

COMPARISON OF AFFIRMATIVE AND NEGATIVE PROOF.

§ 1. We have shown that commensurate proof is better than particular: we proceed to show that affirmative is better than negative. Assume that proof from fewer petitions, hypotheses, or propositions, is, *ceteris paribus*, preferable to a longer deduction: for if the conclusion conveyed is equally certain, the shorter proof conveys it with greater rapidity. To prove commensurately the proposition, that preference should be given to the shorter proof, suppose that the certainty of the premisses is equal, and that the certainty of the conclusions varies according to their order of sequence: and let the conclusion, E is A, be drawn either through the middles, D, C, B, or through the middles, G, F. The proposition, E is A, as concluded in the second deduction, is equally certain with the proposition, D is A, as concluded in the first deduction; but, as concluded in the first deduction, it is not so certain as the proposition, D is A; for a conclusion is not so certain as its ground and antecedent. A preference, therefore, is, *ceteris paribus*, due to the shorter deduction.

Though both negative and affirmative deduction assume three terms and two premisses, yet, as the former only asserts existence, the latter both existence and non-existence, the latter

requires more propositions, and is therefore inferior to the former.[1]

§ 2. Again, we know that one premiss must always be affirmative, as two negatives produce no conclusion: hence, in deducing the premisses from their ultimate laws, the affirmative propositions increase with greater rapidity. If you wish to demonstrate the premisses,

no B is A
all C is B,

interpose the middles D and E: the proposition, no B is A, will follow from the premisses,

no D is A
all B is D;

and the proposition, all C is B, will follow from the premisses,

all E is B
all C is E:

thus the deduction has added one negative and three affirmative premisses. And so in any further prosyllogisms; every affirmative conclusion deriving from two affirmatives, and every negative from a single negative.

If then the ground of proof is more certain and credible than the conclusion; and the affirmative is employed as ground of the negative, but the negative not as ground of the affirmative; the latter, as antecedent and more evident, claims a preference.

§ 3. The element of deduction is a commensurate immediate proposition, and is affirmative or negative according to the conclusion. As existence precedes non-existence, so the affirmative precedes and explains the negative. Affirmative proof, therefore, as composed of preferable elements, is preferable to negative proof.

§ 4. As implied in the existence of negative proof, and not implying it reciprocally, affirmative proof has a more primordial and elementary character.

[1] The commentators observe that this is a fallacy, as the number of premisses has nothing to do with their quality.

CHAPTER XXVI.

COMPARISON OF DIRECT AND INDIRECT PROOF.

§ 1. Having shown that affirmative proof is better than negative, we proceed to show that direct is better than indirect: and first let us examine their difference.

The premisses,

no B is A
all C is B,

furnish a direct proof of the proposition, no C is A. Indirect proof assumes the contradictory of the proposition it wishes to establish, and educes a confessedly false conclusion. If we wish to establish that some B is not A, we assume the premisses,

all B is A
all C is B:

from these results the confessedly false conclusion, all C is A; and as the minor premiss is unquestioned, the major must be false, and therefore some B is not A. The position of the terms in the two syllogisms is similar; but there is a difference in the evidence of the propositions. In the former the proposition, no B is A, is more evident than the proposition, no C is A, and is employed in its direct proof: in the latter the proposition, some C is not A, is better known than the proposition, some B is not A, and is employed in its indirect proof.

§ 2. The proposition, no B is A, which constitutes the evidence in the direct proof, is naturally and absolutely antecedent to the proposition, some C is not A, which gives evidence in the indirect proof; the former being ground, the latter conclusion. The conclusion of indirect proof, some B is not A, is not a proper conclusion,[1] and its evidence, some C is not A, is not the proper ground; the subject of the latter proposition, C, not

[1] The ultimate conclusion of an indirect proof (εἰ συμβαίνει ἀναιρεῖσθαι τί) is not naturally a conclusion; and the premisses (ἐκεῖνα) are not naturally premisses (ἐξ ὧν): for the former, some B is not A, is the sub-

being related to the subject of the former, B, as a whole to a part; which relation constitutes the ground and conclusion of a syllogism. As, then, direct proof employs absolutely antecedent and clearer premisses, it is preferable to indirect, even when its conclusion is negative; much more so when it is affirmative.

CHAPTER XXVII.

COMPARATIVE PERFECTION OF SCIENCES.

§ 1. A science which exhibits the reason of a fact is exacter and holds a higher rank than a science which exhibits the fact alone.

§ 2. The science of an abstract and insulated subject is exacter than a concrete science: as Arithmetic is exacter than Harmonics.

§ 3. The science of a more elementary subject is exacter than that which treats of several elements combined; as Arithmetic than Geometry. There is a combination and complexity of elements in the subject of the one compared with the subject of the other: for points are placed, and units are placeless.

CHAPTER XXVIII.

UNITY OF SCIENCE.

§ 1. It is generically one and the same science which treats of the whole of a genus, including the specific derivatives from its elements, and their parts and essential attributes.[1] Sciences

altern of one of the premisses of demonstrative proof; and one of the latter, some C is not A, is the subaltern of the conclusion of demonstrative proof. τὸ ἐξ οὗ συλλογισμός, means, a natural premiss.

[1] πᾶσαι αἱ ἐπιστῆμαι περὶ ἕν τι καὶ γένος τι περιγραψάμεναι . . οὕτω τὰ καθ' αὑτὰ ὑπάρχοντα τῷ γένει περὶ ὅ εἰσιν ἀποδεικνύουσι.—Met. vi. 1. αἱ ἐπιστῆμαι μέρος τι τοῦ ὄντος ἀποτεμνόμεναι θεωροῦσι περὶ τοῦτο

have not this generic identity, if neither the elements of the one are derived from the elements of the other, nor the elements of both from the elements of the same third science.

§ 2. This must be tested by examining the indemonstrable propositions on which they ultimately rest; for the principles should be homogeneous to the conclusions: and this again may be tested by examining whether the conclusions are homogeneous to one another.

CHAPTER XXIX.

SEVERAL PROOFS OF THE SAME CONCLUSION.

The same attribute is susceptible of several demonstrations, not merely by a remoter term of the same series, but by a term taken from a heterogeneous series. Pleasure may be proved to be change because it is excitement, or because it is supervening calm: which intermediates belong to different categories. They must, however, be mutually attributable,[1] as both are attributes of the same subject. We ought to examine under what conditions the other figures enable us to prove the same predicate by different intermediates.

CHAPTER XXX.

CHANCE.

The effect of chance cannot be a conclusion of demonstrative science, for it is what remains when we exclude the necessary or general. The premisses of deduction are always either necessary or general, and give respectively a necessary or general

τὸ συμβεβηκός.—Met. iv. 1. ἅπαντος δὲ γένους καὶ αἴσθησις μία ἑνὸς καὶ ἐπιστήμη· οἷον γραμματικὴ μία οὖσα πάσας θεωρεῖ τὰς φωνάς. διὸ καὶ τοῦ ὄντος ὅσα εἴδη θεωρῆσαι μιᾶς ἐστιν ἐπιστήμης τῷ γένει, τά τε εἴδη τῶν εἰδῶν.—Met. iv. 2.

[1] There will be a syllogism in Darapti. (B. St. Hilaire.)

conclusion: the result, therefore, of chance, being neither necessary nor general, cannot form a demonstrative conclusion.

CHAPTER XXXI.

SENSATION.

§ 1. Sensation is not science. Though the correlative of sense is generic, the correlative of sensation is particular, determinate in time and place, and incommensurate: the demonstrable is commensurate: sense perception, therefore, is unscientific. If we could see with our eyes that the angles of a triangle are equal to two right angles, we should not, as some assert, already have scientific knowledge, but should want demonstration. A spectator on the moon, who saw the earth intervening, would not know the cause and commensurate reason of eclipse. Repeated sensations, however, disclose the commensurate, and prepare the way for demonstration.

§ 2. The value of the commensurate view arises from its indicating the reason. It is preferable, therefore, to sensation and intellectual intuition only when an effect is separate from its cause, not when an object is elementary.[1]

§ 3. Sense, then, is not the science of the derivative and demonstrable; unless we use the word sense to mean scientific demonstration. It would sometimes, however, put an end to inquiry; not as conferring knowledge, but as leading to a commensurate view. If we saw light permeating the pores of glass, we should know the cause of transparence, sense perceiving the particular, and reason the universal.

[1] It is worth observing that intellectual intuition is here opposed to universal or abstract conception.

CHAPTER XXXII.[1]

MULTIPLICITY OF SCIENTIFIC PRINCIPLES.

§ 1. The principles of all deduction are not identical, as may be shown by dialectical considerations.

[1] This chapter is closely connected with chaps. VII. IX. XXVIII. The chief point in which Plato's Logic differed from Aristotle's seems to have been the closer connection which he made between the Primary and Secondary sciences. He seems to have thought that the ultimate premisses of the secondary sciences are deducible from propositions of some primary science. This is opposed to the rule of Appropriate principles, which guards the variety and multiplicity of the body of truth, that is endangered by the exclusive desire of unity. (*οἱ μὴ ἐκ τῶν οἰκείων ἀρχῶν λόγοι κενοί· ἐκ δὲ τῶν ὑπαρχόντων τῷ γένει θεωρῶν ἂν τις μᾶλλον λάβοι τὴν αἰτίαν.* De Gen. An. ii. 8.) This precept is the assertion of the inductive against the deductive tendency, and always requires to be re-enforced when a new department of nature is to be explored, as the first explanations are generally vain attempts to apply old laws to the solution of new phænomena. See Philosophy of the Inductive Sciences, book ii. 2. Compare Cicero: Omnia hæc, quæ supra et subter, unum esse, et unâ vi atque unâ consensione naturæ constricta esse dixerunt. Nullum est enim genus rerum, quod aut avulsum a cæteris per seipsum constare, aut quo cætera si careant, vim suam atque æternitatem conservare possint. Est enim illa Platonis vera vox, omnem doctrinam harum ingenuarum et humanarum artium uno quodam societatis vinculo contineri.—De Orat. iii. 5.

The question is proposed by Mr. Mill: "Since we are continually discovering that uniformities, not previously known to be other than ultimate, are derivative, and resolvable into more general laws; since (in other words) we are continually discovering an explanation of some sequence, which was previously known only as fact; it becomes an interesting question, whether there are any necessary limits to this philosophical operation, or whether it may proceed until all the uniform sequences in nature are resolved into some one universal law. For this seems, at first sight, to be the ultimatum towards which the progress of induction, by the Deductive method, resting on a basis of observation and experiment, is progressively tending."—System of Logic, iii. 14. He decides "that the ultimate laws of nature cannot possibly be less numerous than the distinguishable sensations or other feelings of our nature."

Firstly, they differ like the conclusions in truth and falsehood: for though a true conclusion may result from false premisses, this is the only case in which premiss and conclusion differ in character. The true conclusion, C is A, may result from false premisses, C is B, B is A: but if the latter are deduced, the premisses of their deduction must be false; for false conclusions can only derive from false premisses, as true premisses involve a true conclusion. Secondly, false principles differ among themselves, for they are inconsistent and contrary.

§ 2. The same may be evinced by an appropriate deduction. The elementary conceptions of many departments of nature are heterogeneous, and inapplicable beyond the limits of their appropriate science. The theory of points, which are placed, cannot introduce into its syllogisms the conception of units, which are placeless. The transferred conceptions would have to appear as predicates of the major term of the science to which they were transferred, or as subjects of the minor, or as intermediates to major and minor: or in all positions; some as superior to the major, others as inferior to the minor, and a remainder as intermediate to major and minor: but they cannot occupy any of these places.

There are no common principles from which all truth can be deduced; such as the canon, that either affirmative or negative must be true.[1] For subjects are heterogeneous; and some predicates are peculiar to the genus of magnitude, others to the genus of quality; and subject and predicate must be both defined, and then conjoined by the general canon.

§ 3. Besides, the number of principles nearly equals the number of conclusions: and for every new conclusion a new proposition introduces a new conception, whether inferior to the minor, intermediate, or superior to the major.

§ 4. Again, as conclusions are infinite, and each succession of (homogeneous) terms is finite, (there must be an infinite variety of heterogeneous successions.[2])

§ 5. Again, some principles are contingent, others necessary.

§ 6. It is plain that, if conclusions are infinite, principles cannot be identical, as we have interpreted the expression. If it

[1] See Locke, as quoted in Appendix A.

[2] See chap. XXII.

is only meant that there are principles of Geometry, principles of Arithmetic, principles of Medicine, and principles of every science, it is absurd to call them identical because they are what they are, for thus every thing is identical.

§ 7. It cannot be meant that every premiss will prove every conclusion; for this is at once refuted by Logical theory, or by inspection of existing sciences: for principles are immediate propositions, and a fresh conclusion cannot be obtained without a fresh immediate proposition. If only primary immediate propositions are allowed to be principles, there is one peculiar primary proposition to every heterogeneous matter.[1]

§ 8. If it is neither asserted that any premiss will prove any conclusion, nor allowed that the premisses of each science are peculiar; it may be maintained that all principles are specifically diverse, but identical in genus. This cannot be, for we have seen that the primary laws of heterogeneous matters are themselves heterogeneous. There are two classes of primary laws: the canons are common to all sciences; the subject, as number, or magnitude, is the exclusive domain of a particular science.

[1] "For example; since there is a phænomenon *sui generis* called colour, which our consciousness testifies to be not a particular degree of some other phænomenon, as heat, or odour, or motion, but intrinsically unlike all others, it follows that there are ultimate laws of colour; that though the facts of colour may admit of explanation, they never can be explained from laws of heat or odour alone, or of motion alone, but that, however far the explanation may be carried, there will always remain in it a law of colour . . . and however diligent might be our scrutiny of the phænomena, whatever number of hidden links we might detect in the chain of causation terminating in the colour, the last link would still be a law of colour, not a law of motion, nor of any other phænomenon whatever . . . . White colour can in no manner be explained exclusively by the laws of the production of red colour. In any attempt to explain it, we cannot but introduce, as one element of the explanation, the proposition, that some antecedent or other produces the sensation of white."—Mill, System of Logic, iii. 14.

CHAPTER XXXIII.

SCIENCE AND OPINION.

§ 1. Knowledge or Science and its object differ from Opinion and its object.

Knowledge is commensurate, and rests on necessary grounds. Contingent truths cannot be objects of knowledge, else they would both be necessary and non-necessary: nor can they be objects of Reason, for Reason is the beginner of Science; nor of indemonstrative science, for this is the apprehension of immediate propositions:[1] and as all apprehension of truth is either Reason, Science, or Opinion, it follows that Contingent truths are the object of Opinion. This is confirmed by phænomena: the truth of Opinion is precarious: this is explained, if its object is the mutable. When a man regards a fact as necessary, he regards himself as possessed of Knowledge, not of Opinion: when he regards it as actual but contingent, he regards himself as possessed of Opinion, not of Knowledge: confirming our position, that the contingent is the object of Opinion, the necessary of Knowledge.

§ 2. Can the same thing in any sense be an object of both Opinion and Knowledge, and can we, without identification of Opinion and Knowledge, maintain that every object of Knowledge may be an object of Opinion? For then Opinion might follow the steps of Knowledge along the intermediates till it arrives at the immediate, and why should the one be Knowledge and not the other? For the reason or intermediate law, as well

[1] Reason, Science, and Opinion, are three species of intellectual apprehension: Reason apprehends first principles, Science necessary conclusions, Opinion contingent propositions.

εἰσὶ δὲ τῆς ὑπολήψεως διαφοραί, ἐπιστήμη, καὶ δόξα, καὶ φρόνησις (νοῦς).—De Animâ, iii. 3.

δυνάμεις καθ' ἃς κρίνομεν, αἴσθησις, δόξα, νοῦς, ἐπιστήμη.—Ibid.

τὸ νοεῖν (ὑπολαμβάνειν) φρόνησις, (νοῦς) καὶ ἐπιστήμη, καὶ δόξα.—Ibid.

as the fact, may be the object of Opinion. Apprehension of a necessary conclusion, based on the definitions which form the legitimate grounds of demonstration, is Knowledge, not Opinion. Apprehension of a proposition as true, but not as educible from essential and definitive theorems, is Opinion, not Knowledge.[1] If based on immediate propositions, it is Opinion both of fact and of reason: if not based on immediate propositions, it is Opinion of fact alone.

§ 3. The object, then, of Science and Opinion is only identical in a manner similar to that in which the object of true and false apprehension is identical. If the object of true and false Opinion were identical in the way in which some explain, among other strange results it would follow, that a false Opinion is no Opinion. But the word Identical is equivocal: the object of true and false Opinion is identical in one sense, and not in another. The commensurateness of diameter and circumference, which is an object of false belief, is not in the same manner an object of true belief. While the material element, the terms of the theorem, is the same, the formal elements are opposed: so that the object of true and false belief must be partly identified and partly distinguished. The same holds with respect to the objects of Science and Opinion. They agree in the subject and predicate of their theorem, and agree in their conjunction, but differ in the mode of their conjunction; the one connecting them necessarily and essentially, the other contingently and accidentally.

§ 4. It follows, that Knowledge and Opinion of the same fact cannot coexist in the same mind: for we cannot believe one and the same truth to be both contingent and necessary.[2] The object of Opinion and Knowledge may be identical in two different minds, but not in the same mind: for we cannot at the same time entertain the two beliefs, that the conjunction of

[1] ὑπάρχειν κατ' οὐσίαν καὶ κατὰ τὸ εἶδος. Science then rests on a knowledge of the Idea according to both Plato and Aristotle. They differed, however, as to the nature of the Idea, though they would express it in the same definition. ὁ Σωκράτης τὰ καθόλου οὐ χωριστὰ ἐποίει οὐδὲ τοὺς ὁρισμούς· οἱ δ' ἐχώρισαν, καὶ τὰ τοιαῦτα τῶν ὄντων Ἰδέας προσηγόρευσαν.—Met. xiii. 4.

[2] The Axiom states that nothing can be the subject of contradictory predicates.

man and animal is accidental or contingent, and essential or necessary.

§ 5. Further distinctions between Inference, Reason, Science, Art, Wisdom, Philosophy, belong rather to Physical or Moral Science than to the present treatise.[1]

CHAPTER XXXIV.

SAGACITY.

Sagacity is a talent of guessing rightly at the intermediate when there is no time for consideration. A man observes that the bright side of the moon always faces the sun, and quickly divines the explanation that her light is borrowed: or observes a man in conversation with a capitalist, and conjectures that his object is a loan: or understands the friendship of two persons by referring it to a common enmity. In all these cases the extremes are observed, and at once deduced from the intermediate causes. The moon, C, shines with light borrowed from the sun, B; and therefore, its luminous face is opposite the sun, A. The conclusion, C is A, is noticed, and immediately analysed into its premisses, C is B, B is A.

[1] Psychology, or at least a portion of it, belongs to Physical science. λεκτέον ἂν εἴη τῷ περὶ φύσεως θεωρητικῷ περὶ ψυχῆς μᾶλλον ἢ τῆς ὕλης, ὅσῳ μᾶλλον ἡ ὕλη δι' ἐκείνην φύσις ἐστὶν ἢ ἀνάπαλιν . . . ἀπορήσειε δ' ἄν τις πότερον περὶ πάσης ψυχῆς τῆς φυσικῆς ἐστι τὸ εἰπεῖν, ἢ περί τινος . . . ἢ οὐκ ἔστι πᾶσα ἡ ψυχὴ κινήσεως ἀρχὴ οὐδὲ τὰ μόρια ἅπαντα . . . δῆλον οὖν ὡς οὐ περὶ πάσης ψυχῆς λεκτέον. οὐδὲ γὰρ πᾶσα ψυχὴ φύσις, ἀλλά τι μόριον αὐτῆς ἓν ἢ καὶ πλείω.—De Part. Anim. i. 1. καὶ περὶ ψυχῆς ἐνίας θεωρῆσαι τοῦ φυσικοῦ, ὅσα μὴ ἄνευ τῆς ὕλης ἐστίν.—Met. vi. 1; Nic. Ethic. vii. 3.

BOOK II.

CHAPTER I.

PROBLEMS OF SCIENCE.

§ 1. Problems and theorems are equal in number: problems are four:

(1) The question of Fact: Has a given subject a certain attribute?

(2) The question of Reason: What is the cause that a given subject has a certain attribute?

(3) The question of Existence: Does a given subject exist?

(4) The question of Essence: What is the nature of a given subject?[1]

§ 2. The word,[2] Whether, when we inquire Whether this or that of certain enumerated cases is true, as when we inquire, Whether or not the sun is eclipsed, generally indicates a question of Fact: for the inquiry ceases when the Fact is known; and, if known at first, the word Whether does not enter the question.

§ 3. The inquiry into the Reason follows upon knowledge of the Fact: when we know that the earth is subject to earthquakes, and the sun to eclipse, we inquire, what is the cause of earthquake and eclipse?

§ 4. It is a different problem, when we inquire into the existence or non-existence of an agency or substance: as when we ask, Is there, or is there not, a centaur? Is there, or is there not, a God?

[1] The two last of these are problems of Inductive, but first principles of Deductive Science; the one being the hypothesis, the other the definition. The attribute, as well as the subject, must be defined (book i. 10), so that, to a certain degree, the second problem also is assumed among the principles of Demonstration.

[2] ἐν τοῖς ἀντικειμένοις ἀεὶ τοῦ ποτέρου ἡ ζήτησις.—Met. x. 5.

§ 5. When we know the Fact that an agency or substance exists, we inquire into its Essence or nature: What is the nature of man? What is the nature of a God?

CHAPTER II.

THE OBJECT OF INQUIRY IS ALWAYS THE INTERMEDIATE.

§ 1. Problems and theorems may be classed as above. When we inquire (1) the Fact, whether a subject possesses an attribute; or (3) the simple Existence of the subject; our inquiry is, Has it, or has it not, an Intermediate?

§ 2. When we know (3) the Existence of a subject, or (1) the Fact that it possesses an attribute; in other words, when we know the simple or modified Existence of the subject; and proceed to inquire (4) into the Essence of the subject, or (2) the Reason of its attribute; then our inquiry becomes, What is the determinate Intermediate?

§ 3. The questions (1), Does the moon wax or wane? Is the moon eclipsed? referring to a particular property of the moon, are questions of modified Existence: (3), the Existence of the moon or of night, if discussed would be a problem of simple Existence.

Two of the problems inquire, Is there an Intermediate? and two, What is the Intermediate? for the object of inquiry is always a Cause, and the Cause enters as an Intermediate. To inquire, Is the moon eclipsed? is to inquire, Is there a Cause of the moon's eclipse? When this is settled we proceed to inquire, What is the Cause of the moon's eclipse? The Cause of a subject's existence, or of its possessing an attribute essential or accidental, always enters syllogism as an intermediate. By the simply existing subject I understand the earth, the sun, the triangle: by their modifications or attributes, equality, inequality, eclipse, interposition.

§ 4. The problem of Reason may be identified with the problem of Essence. The problem and solution, What is the

nature of eclipse? The deprivation of the moon's light by the earth's interposition; are identical with the problem and solution, What is the Cause of eclipse? The earth interposing deprives the moon of light. The question, What is the Essence of harmony? and the answer, A numerical ratio of grave and acute, are identical with the question and answer, What is the Reason of grave and acute harmonizing? Their having a certain numerical ratio. The question, Is it a Fact, that grave and acute possess the attribute of harmonizing? becomes the question, Have grave and acute a numerical ratio? and after this is settled, ensues the question, What is the reason of their harmonizing? or, What is their numerical ratio?

§ 5. Sensible intermediates show that the object of search is always the intermediate; for sensation would render inquiry unnecessary, by indicating the commensurate antecedent. A spectator on the moon would not need to inquire into the Fact or Cause of eclipse, for sense would connect the particular eclipse with the particular interposition; and out of this he would elicit the commensurate conjunction.

§ 6. The knowledge of the Reason, then, is identifiable with the knowledge of the Essence. For the Essence of the subject is the Reason of its simple existence: and the Reason of the attribute constitutes its Essence.

CHAPTER III.

DEFINITION AND DEMONSTRATION HAVE NOT THE SAME PROVINCE.

§ 1. The object, then, of research is always the Intermediate.[1] Let us next examine how the Essence or fundamental character is discovered and explained, and what is the nature

[1] Mr. Whewell asserts (Philosophy of the Inductive Sciences, book ii. chap. 5.) that the discovery of the middle is not so important a step in the progress of science, as the discovery of the major extreme; but he does not observe that what he calls the "second extreme" is really the middle of an original syllogism.

The phænomenon that Kepler ob-

and the object of definition, beginning with a preliminary discussion closely allied to what has preceded; whether the same object under the same aspect is both demonstrable and definable.

§ 2. Some matters of deduction must be indefinable, for syllogism in the second and third figure is negative and particular: but definition, stating what an object is, must always be affirmative and universal.

§ 3. The objects of affirmative conclusions in the first figure cannot all be definable: for, if all knowledge of the demonstrable results from demonstration, all the demonstrable must be indefinable; else, possessing the definition and not the proof, we might know the demonstrable without demonstration.

§ 4. The same may be seen by induction: there was never a case in which an attribute, essential or unessential, was learnt by mere definition.

§ 5. If definition is limited to the characterization of substances, attributes are indefinable.[1]

§ 6. We have shown that some objects of demonstration are indefinable. To show that some objects of definition are indemonstrable, we may repeat one of our former arguments. Unity of the truth implies unity of knowledge; and to know a deducible truth is to possess its deduction: a deducible truth, therefore, cannot be known by definition.

§ 7. Again, definitions are the principles and foundation of deduction: and the principles are indemonstrable: else there would be elements of the elementary, and foundations of the foundation, in endless regression. The primary or limiting truths, therefore, are definitions incapable of deduction.

served, the conclusion of the original syllogism, was:

Mars is seen in certain positions.

After many unsuccessful attempts, Kepler explained this by assuming:

Mars describes an ellipse about the sun.

The elliptical motion of Mars is here the middle; it would be the major of a syllogism, which explained by what forces Mars was impelled in his elliptical course, in which the forces would be the middle.

[1] This, however, is not true. *φανερὸν ὅτι ὁ πρώτως καὶ ἁπλῶς ὁρισμὸς καὶ τὸ τί ἦν εἶναι τῶν οὐσιῶν ἐστιν· οὐ μὴν ἀλλὰ καὶ τῶν ἄλλων ὁμοίως ἐστὶ, πλὴν οὐ πρώτως.*—Met. vii. 4. See Post. Anal. i. 10.

§ 8. The objects of definition, then, and demonstration are not always identifiable: nor are they in any case. For the defined is the essence or fundamental character, and this is always postulated or assumed in science, not demonstrated:[1] as the mathematician assumes, not demonstrates, the nature of Unity, or the nature of Even.

§ 9. All deduction conjoins or disjoins a subject and predicate: in definition there is no subject and predicate. Animal is not attributed to Biped, nor Biped to Animal: Plain to Figure, nor Figure to Plain.

§ 10. Again, Essence differs from Fact: the definable is an Essence, the demonstrable a Fact: and as Essence and Fact are not, like Triangle and Isosceles, related as part to whole, they require a different mode of explanation.

§ 11. We have seen that neither the whole classes of the definable and demonstrable can be identified, nor any of their members:[2] and the same difference that exists between the definable and demonstrable will exist between definition and demonstration.

[1] In the Greek we have ὑποτιθέμεναι τὸ τί ἐστι: this is an inaccurate expression: ὁ γὰρ ὁρισμὸς θέσις μέν ἐστιν, ὑπόθεσις δ᾽ οὐκ ἔστι.—Book i. 2.

[2] The indemonstrability of first truths is expressed by Plato, when he makes Socrates as teacher profess the obstetrical art. (ἄγονός εἰμι σοφίας . . μαιεύεσθαί με ὁ θεὸς ἀναγκάζει, γεννᾶν δὲ ἀπεκώλυσεν. Theæt. § 20.) Ideas and principles must be the spontaneous growth of the mind; they cannot be imparted from without; they are not, like deductive conclusions, implied in previous knowledge; they require a new perceptive power, and the first genuine perception of a great principle is, as it were, a new birth. The only assistance to their development that a teacher can contribute, is the use of the Elenchus, the rejection of unsound maxims and distorted views, by deducing their false consequences, or showing their discordance with acknowledged truth. (βασανίζειν πότερον εἴδωλον καὶ ψεῦδος ἀποτίκτει τοῦ νέου ἡ διάνοια, ἢ γόνιμόν τε καὶ ἀληθές.—Theæt. § 20. ἀλλὰ φέρε δὴ αὐτὸ κοινῇ σκεψώμεθα, γόνιμον ἢ ἀνεμιαῖον τυγχάνει ὄν.—Ibid. § 23.)

CHAPTER IV.

CATEGORICAL PROOF OF A DEFINITION.

Beside the considerations hitherto alleged to show that a definition cannot be deduced, we may observe that the terms of a syllogism in which the essence is demonstrated must be peculiar to one another and reciprocate: if A in the conclusion is peculiar to C, A the major must be peculiar to B the intermediate, and B to C the minor. Again, in order that A in the conclusion may be essential to C, A the major must be essential to B the intermediate, and B to C the minor. Unless we have a pair of essential premisses, if B is not essential to C, as well as A to B, A in the conclusion will not be essential to C. B, then, will be the essence of C, as well as A; and B will be its essence antecedently to A. If C is Man, and A its deducible definition; B the intermediate will be a prior definition, and some other intermediate prior to B. The minor premiss of the deduction will always be a *petitio principii;* for when we assume that C is B, we assume the essence of C. It will be better to suppose that there are only two premisses to the deduction, and these, therefore, primary and immediate; and then it will be clear, that proof by convertible propositions always involves a *petitio principii*, whether Man, the Soul, or anything else is the subject of definition. In order to prove that the soul is the original cause of life, because it is a self-moving number, we must postulate that the soul in its essence is a self-moving number. For if A is merely the predicate of B, and B of C, it does not follow that A is the essence of C. And if A, though essential, is only part of the essence, as animality is part of humanity, and not identical, or the whole essence of B, and B of C; we cannot conclude that A is the whole essence of C. If, on the other hand, the premisses are of this character, then B is the antecedent essence of C, and the demonstration is vitiated by a *petitio principii.*

CHAPTER V.

ESTABLISHMENT OF DEFINITION BY DIVISION.

§ 1. Division, as we saw in the analysis of the figures, cannot enable us to deduce a definition.[1] The conclusion of the process, like the conclusion of induction, is defective in necessity. A conclusion must not be a matter of question or concession, but the inevitable consequence of the premisses, unaffected by concession or denial. In establishing a definition, you ask whether Man is animate or inanimate; and assume, not deduce, that he is animate. Again, after dividing Animal into terrestrial and aquatic, you do not deduce but assume that he is terrestrial.

§ 2. At the end, you do not deduce necessarily, you only assume, that the combination of these elements is the essence of Man. The number of the elements is immaterial. Though the assumptions might warrant some conclusion, the syllogism actually drawn is inconclusive: though it might be inferred that the combination is a predicate of Man, what necessity is there to conclude that it is his definition?

§ 3. Again, how can you be sure that there is no excess nor deficiency in the elements, that none were passed over in the division? This fault, however, though often incurred, may be avoided, if, without pretending to deduction, we assume only essential predicates, and carry on a continuous and unintermittent division till all the elements are exhausted; which must be the case when we arrive at a species no further divisible.

§ 4. In this process, however, as in Induction, though some truth may become evident, it is not by syllogism. Though you close the process by selecting and putting together the definition, you do not conclude: you are just as liable to the question, Why? as if you assert the necessity of a conclusion without having produced any intermediate. You assert the essence

[1] Prior. Anal. i. 31.

of Man to be, wingless, biped, footed, animal: at every stage of the process I demand a proof.

§ 5. You may prove, perhaps, that every thing is mortal or immortal, and continue the subdivision: but this array of subdivided branches is not a definition of Man: so that, though proof enters the division, the definition of Man is not proved.[1]

CHAPTER VI.

HYPOTHETICAL PROOF OF DEFINITION, AND PROOF BY DEFINITION OF THE OPPOSITE.

§ 1. Is Definition susceptible of an hypothetical proof, if we assume as our major, that the reciprocating combination of essential predicates is the definition; and as our minor, that certain predicates are essential, and when combined reciprocate with the subject; and thus conclude that these predicates compose its definition? Here, as in the former case, the minor premiss is a *petitio principii.*

§ 2. Again, in proving we do not define Proof, for the premisses are always related as whole and part: so in deducing a definition we ought not to assume among our premisses the definition of Definition; but as, if our proof is disallowed, we maintain it by defining Proof; so, if our proof of definition is disallowed, we may answer by defining Definition.[2] As we draw a conclusion independently of the definition of proof, so

[1] Though Division is no proof of Definition, yet it is of great use in the investigation of a Definition. See chap. XII.

[2] *τοῦτο γὰρ ἔκειτο ἡμῖν τὸ τί ἦν εἶναι.* The past tense *ἔκειτο* suggests the reason why the *ἦν*, to which it is equivalent in the formula *τί ἦν εἶναι*, is in the past tense. It signifies a definition as employed in proof; and the *ἦν* is in the past tense, because the definition was assumed before it is employed to support a conclusion. At the time of its assumption we may suppose that the present tense was used, as above, where a definition professes to be proved: *τοῦτο ἄρ' ἐστὶ τὸ εἶναι ἐκείνῳ.*

we ought to prove a definition independently of the definition of Definition.[1]

§ 3. A hypothetical demonstration, that assumed the essences of opposites to be opposite, and, as dividedness is the essence of evil, concluded that the essence of good is undividedness, would be similarly guilty of a *petitio principii.* The conception introduced to prove an essence must be an essence, but not identical with the essence to be proved; nor, as in the case of opposites, must they possess the same definition, and reciprocate.

§ 4. Both the proof by division and the proof by hypothesis are liable to the objection, that they introduce in the conclusion a unity among the elements that did not appear in the premisses.[2] Why is Man defined to be a terrestrial biped animal, and not rather, a terrestrial, and a biped, and an animal? Why do these elements combine into a single essence more than the predicates Grammatical and Musical?

CHAPTER VII.

ESSENCE CANNOT BE PROVED.

§ 1. How does Definition unfold the essence, if it neither, like syllogism, shows that from certain assumed existences the existence of something else necessarily follows; nor, like induction, that a law holds because it has no exception? Both these methods prove existence, not essence: what other method remains? The definer, surely, does not point out the essence with his finger as an object of sensation?

§ 2. How can the Essence possibly be exhibited? For knowledge of the essence necessarily involves a knowledge of the existence. We cannot understand the essence of a nonen-

[1] Though the hypothetical proof is not demonstrative, yet it is useful in investigating a definition. See chap. XII. Also proof by the definition of the opposite, though little more than a *petitio principii,* is useful for this purpose. See Nic. Ethic. *πολλάκις μὲν οὖν γνωρίζεται ἡ ἐναντία ἕξις ἀπὸ τῆς ἐναντίας.* Book v. 1.

[2] See Metaph. vii. 12.

tity, such as Goatstag, though we may understand the meaning of the name. How can one and the same method evince both the essence and the existence?[1] For essence and existence are distinct truths; and the object of definition is single, like the object of demonstration.

§ 3. Again, as no truth but essence is indemonstrable, and existence is not essence,[2] for existent is never a genus, it fol-

[1] The difference between Definition and Hypothesis is pointed out by Mr. Mill: the latter he calls a Postulate. "The Definition of a thing, along with the meaning of a name, covertly asserts a matter of fact. This covert assertion is not a Definition, but a Postulate. The accompanying Postulate affirms the real existence of things possessing the combination of attributes set forth in the definition; and this, if true, may be foundation sufficient on which to build a whole fabric of scientific truth." In contending, against Stewart, that Definitions are not the original premisses of science; that the conclusion follows not from the Definition, but from the tacit assumption of a matter of fact; he may seem to have the concurrence of Aristotle, who makes much the same assertion: (*οἱ ὅροι οὐκ εἰσὶν ὑποθέσεις....ἀλλ' ἐν ταῖς προτάσεσιν αἱ ὑποθέσεις....εἰσὶ γὰρ ὑποθέσεις ὅσων ὄντων τῷ ἐκεῖνα εἶναι γίνεται τὸ συμπέρασμα.*)—Post. Anal. i. 10. Speaking too of premisses he only names the hypotheses: (*αἱ ἀρχαὶ καὶ αἱ λεγόμεναι ὑποθέσεις αὗταί εἰσι.* Post. Anal. i. 19. See also Prior. Anal. ii. 17, and Nic. Eth. vii. 8. *ἀρχή, ὥσπερ ἐν τοῖς μαθηματικοῖς αἱ ὑποθέσεις*:) however, at other times he only specifies the Definitions, (*ἔτι, αἱ ἀρχαὶ τῶν ἀποδείξεων ὁρισμοί....ἢ τὰ πρῶτα ὁρισμοὶ ἔσονται ἀναπόδεικτοι.*—Post. Anal. ii. 3. *καὶ ἀρχὴν ἐπιστήμης εἶναί τινα φαμέν, ᾗ τοὺς ὅρους γνωρίζομεν.*—Post. Anal. i. 3.) the truth being, that both of these elements, as well as the Axioms, are necessary. (*ἐνίας μέντοι ἐπιστήμας οὐδὲν κωλύει ἔνια τούτων παρορᾶν ... ἀλλ' οὐδὲν ἧττον τῇ γε φύσει τρία ταῦτά ἐστι.* Post. Anal. i. 10.) Mr. Mill indeed says that the Postulates are the premisses on which the theorems depend; and while these are retained, it would make no difference in the certainty of geometrical truths, though every Definition were laid aside; and that the conclusions which seem to follow from a Definition do not follow from the Definition as such, but from an implied Postulate. (System of Logic, book i. 8. § 6, 7.) But, like Aristotle, he makes the Postulate include the Definition; for it is the idea or object presented by a Definition which is of importance in demonstration, not the name by which this idea or object is symbolized.

[2] This is not accurate: only the existence of the attribute or effect is demonstrated: the existence of the primary substance or cause is assumed in the Postulate or Hypothesis. (Post. Anal. i. 10.; also ii. 8. *τὰ ἄμεσα καὶ τὰς ἀρχὰς καὶ εἶναι*

lows, that all existence is demonstrable. This is verified by the processes of the actual sciences: the geometer assumes the conception of Triangle, but demonstrates its existence. What, then, does definition unfold? It cannot unfold the essence of Triangle, for we cannot know the essence without knowing the existence.

§ 4. The recognized definitions never prove existence. You define a circle to be a line equidistant from a middle point. What necessity is there that such an object exists? and again, why is such an object a circle and not bronze? Definitions neither evince the possibility of their objects' existence, nor that they belong to the object professedly defined, but are always open to the question, Why?

§ 5. As definition must unfold either the essence of a reality or the meaning of a word, and cannot unfold the essence, is it any sentence unfolding the signification of a word? No: else nonentities would be definable, for their name may have a signification: and all speech would be definitions; for every sentence might be named; and the contents of the Iliad would be a definition of the name. Besides, the signification of a word can no more be evinced by demonstration or definition than the essence of a reality.

§ 6. It is clear that demonstration and definition, and the objects of each, are distinct: and that definition is not demon-

καὶ τί ἐστιν ὑποθέσθαι δεῖ, and Metaph. vi. 1. *φανερὸν ὅτι οὐκ ἔστιν ἀπόδειξις οὐσίας οὐδὲ τοῦ τί ἐστιν, ἀλλά τις ἄλλος τρόπος τῆς δηλώσεως. ὁμοίως δ' οὐδ' εἰ ἔστιν ἢ μή ἐστι τὸ γένος περὶ ὃ πραγματεύονται, οὐδὲν λέγουσι, διὰ τὸ τῆς αὐτῆς εἶναι διανοίας τό τε τί ἐστι δῆλον ποιεῖν καὶ εἰ ἔστι τοῦτο.*)

The difference between Existence and Essence, i. e. between Hypothesis and Definition, is pointed out by Plato, Theæt. § 139, and § 147, *ἀπεδεχόμεθα ὅτι τῶν πρώτων οὐκ εἴη λόγος, ἐξ ὧν τὰ ἄλλα σύγκειται, διότι αὐτὸ καθ' αὐτὸ ἕκαστον εἴη ἀσύνθετον, καὶ οὐδὲ τὸ εἶναι περὶ αὐτοῦ ὀρθῶς ἔχοι προσφέροντα εἰπεῖν.* He seems to point out the distinction between peculiar and common principles, i. e. between Theses and Axioms, when he makes some of the birds in his aviary keep in flocks separate from the rest, while others pass from one flock to another, and fly about everywhere. *ἐν ἑκάστῃ ψυχῇ ποιήσωμεν περιστερεῶνά τινα παντοδαπῶν ὀρνίθων, τὰς μὲν κατ' ἀγέλας οὔσας χωρὶς τῶν ἄλλων, τὰς δὲ κατ' ὀλίγας, ἐνίας δὲ μόνας διὰ πασῶν ὅπῃ ἂν τύχωσι πετομένας.*—Ibid. § 131.

strative; and that essence can be discovered neither by demonstration nor by definition.

CHAPTER VIII.

TWO KINDS OF DEFINITION.

§ 1. We must now reconsider whether any of the above statements are inaccurate; and again inquire what is the nature of definition; and whether essence in any sense is definable or demonstrable, or absolutely indefinable and indemonstrable. To know the essence, as we said, is the same as to know the reason of the existence.[1] For every thing has a reason: and this is either identical with the object or distinct; and if distinct, either demonstrable or indemonstrable. If one cause is demonstrable, another indemonstrable cause must be the intermediate; and the proof is in the first figure, and the conclusion affirmative and universal. In this mode of demonstrating the essence, we prove one definition by another; for the intermediate that proves an essence or a peculiar predicate must itself be an essence or a peculiar predicate. Of two definitions, then, one is proved and the other assumed: and, as we said before, this is not a demonstration, but a dialectical proof, of the essence.[2]

§ 2. We will now start again, and show how far demonstration is concerned with the essence.

Knowledge of a cause is either subsequent to knowledge of the fact or simultaneous, but never antecedent: in like manner knowledge of the essence never can precede knowledge of existence.

§ 3. Knowledge of existence is either accidental, or implies a partial perception of the essential character:[3] as when we both know the existence of thunder, and that it is a certain noise in the clouds: or the existence of eclipse, and that it is a certain

[1] Post. An. ii. 2. [2] Post. An. ii. 4. [3] Knowledge of the existence is essential when simultaneous to knowledge of the essence.

loss of light: or the existence of man, and that he is a certain animal: or the existence of the soul, and that it is a certain self-moving power. Accidental knowledge of the existence is no advance towards knowing the essence. To inquire into an object's nature, without adequately knowing that it exists, is to inquire into a nonentity. But a knowledge of its existence, in which the object itself is partially recognized, is a step towards a conception of its nature: so that the two kinds of knowledge vary together in their degree of completeness.

§ 4. Suppose that the object is partially perceived: and, in the first case, let A represent Eclipse, C the Moon, and B the Earth's interposition. To inquire whether C is A—whether the moon is eclipsed—is to inquire whether C is B,—whether she has experienced the earth's interposition; that is, whether she has satisfied the definition of A:[1] if this can be asserted in a minor premiss, we assert the conclusion. Or, it is to inquire, which of the contradictory majors, A or not-A, is defined by the existing intermediate B: whether the conditions of containing angles equal to two right angles, or the conditions of the contradictory predicate, are satisfied by the triangle. When the premisses are immediate truths, they furnish a simultaneous knowledge of fact and of reason.

§ 5. Otherwise they inform us of the fact alone: if our proving intermediate is the phænomenon, that at full moon bodies, between which and the moon there is no intercepting body, cast no shadow, we know the fact of eclipse without the cause, the existence without the essence.

§ 6. When we know the fact that C is A, to inquire into its reason, B, is to inquire into the definition of A the major: is it the earth's interposition, or the moon's extinction, or rotation on her axis? Let C represent a Cloud, A Thunder, B the extinction of fire. What is the reason that a cloud thunders?[2] Because fire is extinguished in the cloud. We have the syl-

[1] That λόγος here means definition appears from a passage below: *καὶ ἔστι γε λόγος τὸ* B *τοῦ* A *τοῦ πρώτου ἄκρου*: and from chap. XIV. *ἔστι δὲ τὸ μέσον λόγος τοῦ πρώτου ἄκρου· διὸ πᾶσαι αἱ ἐπιστῆμαι δι' ὁρισμοῦ γίνονται.*

[2] This definition is given by Anaxagoras, and rejected by Aristotle. (Meteor. ii. 9.) His own ac-

logism, C is A, because C is B, and B is A: and the middle term, B, is the definition of A the major: assuming that the definition of Thunder is, the extinction of fire in a cloud. If there is another intermediate, it will be a prior definition.[1]

§ 7. Such is the method by which the essence is discovered: and it appears that the definition is not demonstrable, and yet involves a demonstration. It is true, as appeared in the preliminary discussion, that essence is indemonstrable: but it is also true, that, when an object is distinct from its cause, its definition involves a demonstration.

§ 8. While some objects are thus distinct from their cause, others are identical: the essence of the latter is immediate and elementary: and both their existence and definition must be assumed in an hypothesis, or otherwise unfolded: as the definition and existence of the monad are assumed by the arithmetician. When objects have an intermediate and a distinct cause, their existence and essence are unfolded in demonstration, though their essence is not directly demonstrable.

count may be given in the words of his scholiast, (p. 269 of Ideler's edition,) *γίνεται βροντὴ ἐκ τῆς καπνώδους ἀναθυμιάσεως ἐν τῷ νέφει ἀποκλειομένης καὶ, τοῦ νέφους ἔξωθεν πυκνουμένου διὰ τὴν ψύξιν, ἐκπυρηνιζομένης βιαίως καὶ νέφη τινὰ πληττούσης καὶ πάταγον ποιούσης.* Compare his account of Wind: *ἄνεισιν ἡ καπνώδης ἀναθυμίασις καὶ φέρεται πλησίον τοῦ ἀπογείου ἀέρος, καὶ προσπταίουσα κύκλῳ κινουμένῳ σώματι χεῖται καὶ πεπλανημένην εἰς τὰ πλάγια κίνησιν ποιεῖται.*—Ibid. p. 240, and of Rain: *τὸ περὶ τὴν γῆν ὑγρὸν ὑπὸ τῶν ἀκτίνων καὶ ὑπὸ τῆς ἄλλης τῆς ἄνωθεν θερμότητος ἀτμιδούμενον φέρεται ἄνω· τῆς δὲ θερμότητος ἀπολιπούσης τῆς ἀναγούσης αὐτὸ, συνίσταται πάλιν ἡ ἀτμὶς ψυχομένη καὶ γίνεται ὕδωρ, γενόμενον δὲ φέρεται πάλιν πρὸς τὴν γῆν.*—Meteor. i. 9. Many other examples of causal definition may be found in this treatise, which, like that cited from Anaxagoras, though false as doctrines of physical science, may serve as models in point of form.

[1] This is the case when the cause is not only distinct, but also demonstrable. (*ἔστι τι αἴτιον, καὶ τοῦτο ἢ τὸ αὐτὸ ἢ ἄλλο, κἂν ᾖ ἄλλο, ἢ ἀποδεικτὸν ἢ ἀναπόδεικτον.*—See beginning of chap.) Such a demonstration would be the *petitio principii* discussed in chap. IV.

CHAPTER IX.

DIFFERENT KINDS OF DEFINITION.

§ 1. Definition is an exposition or statement exhibiting the essence: one kind exhibits the signification of a name, or of an expression, such as, Triangular character, used instead of a name. When we know that an object exists corresponding to the name, we investigate its cause; a difficult investigation, because, as we said above, its very existence is hitherto unknown, or only accidentally known.

§ 2. The Unity of a statement is constituted by aggregation: as the Iliad is one aggregate of many statements: or by essential unity in the subject and predicate of a proposition.

§ 3. Besides nominal definition there is real definition; a statement exhibiting the cause of existence. The former indicated without proof: the latter is a demonstration of the essence without a demonstrative form. When it is asked, Why does it thunder? the answer is, Because fire is extinguished in a cloud. When it is asked, What is thunder? the answer is, The extinction of fire in a cloud. One and the same statement, disguised in form, becomes a definition, or a proximate demonstration.[1]

§ 4. Another definition is the conclusion of an essential demonstration:[2] as when we define Thunder, a certain noise in the clouds.

[1] i. e. a demonstration by the immediate cause.

[2] *οὐ γὰρ μόνον τὸ ὅτι δεῖ τὸν ὁριστικὸν λόγον δηλοῦν, ἀλλὰ καὶ τὴν αἰτίαν ἐνυπάρχειν καὶ ἐμφαίνεσθαι· νῦν δὲ ὥσπερ συμπεράσμαθ' οἱ λόγοι τῶν ὅρων εἰσίν.*—De Anima, ii. 2.

Several questions may be asked with respect to these causal definitions.

a. Definitions consist of cause and effect; they also consist of genus and difference. What is the relation of the cause and effect to the genus and difference? Is the cause a generic or a differential element? Or are genus and difference only constitutive of the formal cause, so that the other causes are neither generic nor differential?

b. This suggests another question:

§ 5. Definition of the immediate is an indemonstrable thesis, or position of an essence.

§ 6. Real definition, it appears, has three species:[1]

(1) An indemonstrable statement of the essence.

(2) A deduction of the essence without the deductive form.

(3) A conclusion of a deduction of the essence.

§ 7. We have now inquired how far essences are demonstrable or indemonstrable, and what essence is demonstrable: and how many kinds and objects of definition there are, and how far it proves the essence: and how far demonstration and definition are identical in object, and what is their relation.

CHAPTER X.

CAUSATION.

§ 1. Science is knowledge of a cause: there are four sorts of cause: the formal; the material, or the necessitating antecedent; the efficient, or the first excitement: and the final: all of these appear as intermediates.

What is the relation of the formal to the other causes? for they ought to be contradistinguished; and yet in many cases it would seem to be impossible to give the form or essence of an object without specifying its material, efficient, or final cause; as in the definition of Eclipse, or Thunder, in the preceding chapter. Or is form equivocal, in one sense excluding the other causes, in another including the *proximate*, efficient, final, or material cause; as may be implied in the words, ὁ αὐτὸς λόγος ὡδὶ μὲν ἀπόδειξις συνεχὴς, ὡδὶ δὲ ὁρισμός? chap. IX.

c. Cause and effect are essentially connected, and two modes of essential connection are described, book i. chap. IV. and XXII. In which of these ways are cause and effect related? Is the cause a predicate of the effect, and found in its definition, as animal in the definition of Man? or is it a subject of the effect, and found in its definition, as number in the definition of Odd? Or are some causes related in one way, and others in the other, the formal and final in the former, the efficient and material in the latter? Or are they related in none of these modes? for these seem properly the relations of species to genus and to specific property.

[1] See Post. Anal. i. 8.

§ 2. The necessitating antecedent cannot be traced in less than two propositions:[1] their common intermediate necessitates the conclusion. Let us take an example: Why is the angle in a semicircle a right angle? What antecedent necessitates this predicate? Let A represent a right angle: B the half of two right angles: C the angle in a semicircle. From the propositions, C is B, B is A, we conclude that C is A; which means, that the angle in a semicircle is a right angle: and B is the antecedent that necessitates this conclusion. The interpretation of symbols resembles verbal definition.

§ 3. The formal cause as intermediate has already been explained.

§ 4. We inquire the efficient cause when we ask, What was the origin of the Persian war? Why were the Athenians attacked? Because they assaulted Sardis with the Eretrians. Let A represent war, B unjust aggression, C Athens: A is conjoined with C, because A and B, B and C are conjoined. The assault on Sardis, the first movement or original impulse of the war, appears as the intermediate.

§ 5. When we ask, Why does a man take exercise? For health: Why is a house built? For the preservation of property: Health and Preservation are the motive or final cause. Suppose that exercise is the efficient cause of digestion, and digestion the efficient cause of health: and let C represent exercise, B digestion, A health. In the efficient-cause syllogism the intermediate that conjoins A with C is the efficient cause B, which enters into the definition of the final cause A. In the final-cause syllogism the existence of the fact, that C is B, is explained by the mediation of A the motive. The propositions of a syllogism should be inverted,[2] and then the relation of the efficient and final causes will be clearer.

[1] *αἱ ὑποθέσεις τοῦ συμπεράσματος ὡς τὸ ἐξ οὗ αἴτιά ἐστι.*—Phys. Aus. ii. 3.

[2] The inversion of a syllogism is when the conclusion and one of the premisses change places. For the meaning of *μεταλαμβάνειν*, see Topics, viii. 12. *τὸ γὰρ ἀντιστρέφειν ἐστὶ τὸ μεταλαβόντα τὸ συμπέρασμα μετὰ τῶν λοιπῶν ἐρωτημάτων ἀνελεῖν ἓν τῶν δοθέντων.* The following is an example. The eye sees because it is of a certain structure; here the mechanism (B) of the eye

§ 6. The terms of the final-cause syllogism do not preserve the order of occurrence observed in the efficient-cause syllogism. In the syllogism that exhibited the efficient cause, the middle term, Aggression, was the earliest occurrence: in the syllogism explaining the motive, the minor term, Exercise, is the earliest occurrence: the middle term, Health, the latest.

§ 7. A fact may be necessitated by the material cause, and yet have a design:[1] as light issues from a lantern in consequence of the material necessity that corpuscles escape through pores too large to retain them, (if we assume that bodies are

(C) is the efficient cause of sight (A); and we have the following syllogism:

all B is A
all C is B
∴ all C is A.

But the eye is of a certain structure in order that it may see: sight is the final cause of the mechanism of the eye. In the syllogism by which this is expressed,

all A is B
all C is A
∴ all C is B,

the minor and conclusion of the former syllogism have changed places.

[1] A lantern (A) emits light (C) because it is of a porous material (B), and in order to guide us in the dark (D). The proposition, A C, may be proved by either of the middles, B or D; the proposition, A D, may be proved by the middle B, and the proposition, A B, may be proved by the middle D. The difficulty of reconciling the efficient and material with the final cause, a question which is here so briefly dismissed, has been one of the chief points on which the schools of philosophy have split, some adopting the materialistic, others the spiritualistic theory. Kant attempts a reconciliation in his Critic of the Judgment. See Plato, Phædo, § 106; also Trendelenberg's Logic. The conclusion deducted from a final cause indicates the necessary condition for realizing a proposed end, and is said to possess an hypothetical necessity. *τοῦτο δ' ἐστὶν ὥσπερ ἐξ ὑποθέσεως. ὥσπερ γὰρ, ἐπεὶ δεῖ σχίζειν τῷ πελέκει, ἀνάγκη σκληρὸν εἶναι, εἰ δὲ σκληρὸν, χαλκοῦν ἢ σιδηροῦν, οὕτως καὶ ἐπειδὴ τὸ σῶμα ὄργανον, ἕνεκα γάρ τινος, ἀνάγκη τοιονδὶ εἶναι καὶ ἐκ τοιωνδὶ, εἰ ἐκεῖνο ἔσται.*—De Part. An. i. 1. *οἷον, διὰ τί ὁ πρίων τοιοσδί; ὅπως τοδὶ καὶ ἕνεκα τουδὶ. τοῦτο μέντοι τὸ οὗ ἕνεκα ἀδύνατον γενέσθαι ἂν μὴ σιδηροῦς ᾖ· ἀνάγκη ἄρα σιδηροῦν εἶναι, εἰ πρίων ἔσται καὶ τὸ ἔργον αὐτοῦ. ἐξ ὑποθέσεως οὖν τὸ ἀναγκαῖον.*—Phys. Ausc. ii. 9. Practical deliberation proceeds from the final to the discovery of the efficient cause, and is based on a definition of the former. *ἡ ἀρχὴ ἀπὸ τοῦ ὁρισμοῦ καὶ τοῦ λόγου. ὁρισαμένῳ γὰρ τὸ ἔργον τοῦ πρίειν, ὅτι διαίρεσις τοιαδὶ, αὕτη δ' οὐκ ἔσται, εἰ μὴ ἕξει ὀδόντας τοιουσδὶ, οὗτοι δ' οὐ, εἰ μὴ σιδηροῦς.*—Ibid. Compare Nic. Eth. vi. 12.

transparent by the transmission of light through their pores,) and in order to guide us in the dark. There is no reason why the origin of a fact as well as its permanence should not be due to two causes: as for instance, in the case of thunder: it is quite possible that the roar and hissing may be the necessary effect of the extinction of fire in a cloud, and that it may be designed, as the Pythagoreans said, to strike awe into the inhabitants of Tartarus. Cases like this are very numerous in natural productions and processes: for there are two kinds of nature; one a necessary agent, the other acting with design.

§ 8. Necessity is of two kinds; Nature, or the internal impulse, and Violence, opposed to the internal impulse: a stone is necessitated to move upwards and downwards, but not by the same kind of necessity.

§ 9. Some productions of human intelligence, as a house or a statue, never arise by chance or by necessity, but always by design: others, as health or preservation from danger, may result from chance. Contingencies, when not produced by chance, and when the end is good, are most obviously designed by nature or man. Chance is inconsistent with design.

CHAPTER XII.

SUCCESSION OF CAUSE AND EFFECT.

§ 1. As existing effects are explained by existing intermediates, so past, present, and future effects are explained by past, present, and future intermediates.[1] The moon will be eclipsed because the earth will intervene; was eclipsed because the earth did intervene; is eclipsing because the earth is intervening. Suppose that ice is water solidified: and let C be water; A solidified; B the intermediate, complete departure of heat:

[1] Perhaps ὂν should be translated *eternal*; for that which is eternal may have a cause. *Δημόκριτος δὲ τοῦ ἀεὶ οὐκ ἀξιοῖ ἀρχὴν ζητεῖν, λέγων οὐκ ὀρθῶς· καὶ γὰρ τὸ τρίγωνον ἔχει δυσὶν ὀρθαῖς ἀεὶ τὰς γωνίας ἴσας· ἀλλ' ὅμως ἐστί τι τῆς ἀϊδιότητος ταύτης ἕτερον αἴτιον· τῶν μέντοι ἀρχῶν οὐκ ἔστιν ἕτερον αἴτιον ἀϊδίων οὐσῶν.*—Phys. Ausc. viii. 1.

Ice forms while B is happening; has formed when B has happened; will form when B shall happen.

§ 2. Such effects and causes, whether past, present, or future, are simultaneous both in occurrence and duration: other causes and effects are not synchronous, but successive: past effect succeeding past cause; present effect present cause; and future effect future cause.

If both events are past, the antecedent may be inferred from the subsequent, and the intermediate will also be a past event. But the subsequent cannot be inferred from the antecedent: for whether the interval between them is definite or indefinite, it is false to assert the subsequent before the interval has elapsed.

There is the same relation between two present or two future events.

§ 3. From a past occurrence, as minor, we cannot infer a future occurrence, as major: for the intermediate must be homogeneous to minor and major, whether past, present, future, or eternal; and the same middle cannot be homogeneous both to past and to future. Besides, whether the interval is definite or indefinite, before it elapses the latter cannot be asserted.

§ 4. It should be inquired, what is the principle of continuity between present and past events: or rather, it is clear that two past events are limits or atoms, and resemble points in their indivisibility and discontinuity: and that, as lines contain an infinite number of points, so present of past events; and the latter as well as the former are incapable of continuity.

This subject, however, must be treated more fully in the general theory of production.

§ 5. When the rise of events is successive, the primary cause is immediate. Let A, C, D, be successive past occurrences; then C, compared with A, is a principle or intermediate, as nearer to the Now, or present moment, the beginning of time. If D has occurred, C has occurred; and if C has occurred, A has occurred: therefore, if D has occurred, A has occurred, by the intermediation of C. However long we proceed in this manner, we shall never have filled up the interval with immediate links, but there will always be room remaining for infinite intercala-

tions; there being, as we said, no continuity between events that have past. Yet the Now furnishes us with a primary and immediate point of departure.

§ 6. The same is true of future events: if the subsequent D takes place, the antecedent A will have taken place, as may be proved by the intermediate C. If D takes place, C will have taken place; and if C takes place, A will have taken place: therefore, if D takes place, A will have taken place. This series also is infinitely divisible, for future events are discontinuous: yet here, too, the ultimate point of departure is immediate.

§ 7. This may be exemplified. If a house was built, the intermediate laying of the foundation proves that stones were shaped:[1] if a house was built, the foundation was laid; if the foundation was laid, stones were shaped: therefore, if a house was built, stones were shaped.

Again, if a house shall be built, the same term will serve as intermediate to show that stones will be shaped.

§ 8. Nature presents a perpetual cycle of occurrences:[2] this may be explained in a syllogism whose middle and extremes are convertible: then all the three propositions may be obtained by reciprocal generation, each appearing at one time as premiss, at another as conclusion, the reasoning proceeding in a circle. The following phænomena furnish an example. When the earth is wet with rain, an exhalation rises; when an exhalation rises, a cloud forms; when a cloud forms, rain follows, and the earth is saturated: so that the same term recurs after a cycle of transformations. Every occurrence has another for its consequent; and this consequent another, and so on, till we are brought round to the primary occurrence.

§ 9. In some occurrences the attribute is commensurate to the subject; in others, as the growth of a beard, the attribute is

[1] De Gen. et Corr. ii. 10.

[2] τῷ λειπομένῳ τρόπῳ συνεπλήρωσε τὸ ὅλον ὁ θεὸς, ἐνδελεχῆ ποιήσας τὴν γένεσιν· . . . διὸ καὶ τἄλλα, ὅσα μεταβάλλει εἰς ἄλληλα, μιμεῖται τὴν κύκλῳ φοράν· μόνη γὰρ ἡ κύκλῳ συνεχής.—De Gen. et Corr. ii. 9.

εἰ ἄρα τινὸς ἐξ ἀνάγκης ἁπλῶς ἡ γένεσις, ἀνάγκη περικυκλεῖν καὶ ἀνακάμπτειν . . . ἀντιστρέφειν ἄρα ἀνάγκη ἔσται.—Ibid. ii. 10.

δεῖ δὲ νοῆσαι τοῦτον ὥσπερ ποταμὸν ῥέοντα κύκλῳ ἄνω καὶ κάτω· καὶ τοῦτ' ἐνδελεχὲς ἐθέλει γίγνεσθαι.—Meteor. i. 9.

only general, not universal: the latter results from a general intermediate. If A were commensurate to B, and B to C, A would be commensurate to C; that is, predicated at all times of all its individuals. By hypothesis, C and A are only generally conjoined; therefore the intermediate and extremes are only generally conjoined: therefore there are immediate general propositions.

CHAPTER XIII.

ESTABLISHMENT OF DEFINITION.

§ 1. Having explained how essence is defined, and how far it is definable or demonstrable, let us examine how its elements must be discovered.

Some universal predicates are more extensive than the species, though confined to the genus; entity is predicable of the triad, and of other subjects beyond the genus Number; but Odd, though predicable of other subjects, such as the pentad, is predicable of nothing beyond the genus Number. The primary combination of such predicates that is not wider than the subject is its definable essence. A triad is a number, is odd, is prime, whether as not measured by a single number, or as not compounded of several numbers. The combination of these elements is its essence; for though the second is common to all odd numbers, and the last to the duad; the whole combination is predicable of none but the triad.

§ 2. As commensurate and essential predicates are necessary, this combination of predicates to the triad is necessary. If it is not the whole essence, it must be a genus: but then it would be more extensive than the triad; assuming that this is the character of a genus. Assume further that the ultimate or lowest essential predicate, that is, an essential predicate incapable of further subdivision, is the essence;[1] and that combina-

[1] Such an assumption makes the proof Dialectical, not Demonstrative. See chap. VI.

tion of elements must be the definition of the triad, or any other subject which satisfies these conditions.

§ 3. In treating of any subject-matter, such as number or figure, we should obtain by division the lowest and indivisible classes of its elementary members—the duad, the triad, the straight line, the circle, the right angle; and after defining these classified elements, and observing the category of quantity, quality, or the like, to which they belong, proceed to elicit their peculiar properties, developing them by means of the common canons or axioms.[1] For the attributes of what is compounded of the elementary may be deduced from these definitions; for the essence of the elementary is the ultimate ground of the attributes of the class, which are essentially connected with the elementary alone, and thence imparted to the compound.[2]

§ 4. Division by differentiæ is useful; though, as said above,[3] the essence cannot be deduced or demonstrated, but is finally assumed just as much as if no division had preceded. It is important, however, to determine in what order the elements should be arranged; whether as animal, tame, biped, or biped, animal, tame. Every object is the union of two elements; animal unites with tame, and the result uniting with a new differentia composes the essence of Man; and the right order in which the new elements should be assumed, so as to unite the right genus to the right differentia, can only be learnt by Division.

§ 5. Again, this is the only security against omitting any elements of the essence. After we have assumed the primary genus, unless we subdivide by proximate differentiæ, the division cannot be exhaustive; whole-winged, for example, and divided-winged is not an exhaustive division of animal, but of winged animal. The primary differentia of animal, or of any other genus—whether coordinate to animal, or, like fish and bird, subordinate—must comprehend every individual, whether animal or fish or bird: and then we may be sure that we have made no omission in the elements of the essence, of which we otherwise should have no guarantee.

[1] Post. Anal. i. 32. [2] Eth. Eudem. ii. 6. [3] Chap. v.

§ 6. Definition and division, some assert, suppose universal knowledge, since an object is only known when we know its contradistinguishing differentiæ; and its contradistinguishing differentiæ cannot be known, unless we know all the objects from which it is contradistinguished; for, say they, objects are distinct or identical by the presence or absence of differentiæ. But it is not true that every differentia destroys identity. Objects identical in kind may possess unessential differentiæ. Secondly, if you divide by contradictory differentiæ, and know to which division the object under discussion belongs, it is quite superfluous to know what objects possess the other differentia; but as soon as we reach an indivisible class, the exhibition of the essence is complete. It is no petition or mere hypothesis to assert that every object falls under one or the other of two contradictory divisions;[1] for contradictory differentiæ must exhaust a genus.

§ 7. Three rules must be observed in defining: the elements must be generically essential; they must be arranged in order; and they must exhaust the essence.

As there are dialectical topics for establishing an accident, so there are for establishing a genus;[2] and these will aid us to satisfy the first requisite.

§ 8. To determine the order, we may assume that the primary genus is that which is universally predicable of the others, and of which the others are not universally predicated. Such an element there will be found to exist: and the order of the rest may be determined by the same criterion; for when a prior class is excluded, the next following is primary of the remainder. Exclude the first, and the second is primary; exclude the first and second, and the third is primary.

§ 9. The enumeration will be complete, if we divide the primary genus by exhaustive differentiæ, and the successive subgenera in like manner, till we ultimately reach a genus which has no further differentia; or, till the subject's ultimate genus, combined with the ultimate differentia, is susceptible of no

[1] This assertion is the Axiom.

[2] This is the chief flaw in Aristotle's Logic: for some more rigorous method than the Dialectical, the method of Opinion, ought to be employed in establishing scientific principles.

further division. Nothing is superfluous, for all the elements are substantial; and nothing is omitted: if any element is left out, it must be either a genus or a differentia: neither supposition is possible; for the genus is the primary class, either alone, or in combination with the differentiæ: and the series of differentiæ was exhausted, as the last we came to was by hypothesis indivisible.

§ 10. To find a definition, we should first look for the point of identity in a set of similar individuals that have no contradistinguishing differentia; and then examine a second set, distinct from the former in species, but identical in genus: and after finding the point of identity between the members of the second set, and so of a third, compare the specific characters thus obtained, and see if they present any higher point of identity: and if we find a single all-pervading character, this will be the definition; if not, the subjects examined are not one, but several. For instance, to define magnanimity, we should examine what quality is common to a set of persons known to possess the attribute of magnanimity. Alcibiades, Achilles, and Ajax were magnanimous: in what did they agree? In impatience of dishonour; which made one a traitor, roused another's wrath, and drove another to self-slaughter. Again, in what did a different set, Lysander and Socrates, agree? In equanimity in adversity and prosperity. What element is common to these characters, equanimity in vicissitudes, and impatience under dishonour? If there is nothing in common, there are two distinct kinds of magnanimity.

§ 11. Definition must always be commensurate: for a physician does not prescribe for a single eye, but for a whole genus or species. Particular definition, however, is easier, and therefore should precede as a preliminary. Equivocation is more readily detected in dealing with particulars than with universals: and perspicuity is as indispensable to definition as sequence to demonstration. To attain this, therefore, we should begin by defining separately the subgenera; similarity of colour, similarity of figure; acuteness of sound, acuteness of figure; and afterwards proceed to similarity and acuteness in general, with an especial jealousy of equivocations.

As metaphorical reasoning is unscientific, so is metaphorical

definition; whether the words we define, or the words by which we define, are metaphorical; for this would necessarily produce metaphorical reasoning.

CHAPTER XIV.

EXPLANATION IS RESOLUTION INTO HIGHER OR ANTECEDENT LAWS.

§ 1. To solve the problems of a science, our preliminary information should be collected and arranged as follows:[1] we should divide wholes into their parts, and genera into their species; and place first the attributes of the whole genus; if the inquiry is zoological, the characteristics of the whole animal kingdom; next the characteristics of the immediate subdivisions; of the whole subgenus bird for instance; and the remainder in like manner. This will enable us to deduce or explain the characteristics of the subgenera. Let A represent animal, B animal characteristics, C D E particular animals, as man or horse. Then A will be the reason why B is predicated of C.

§ 2. We should not confine our observations to commonly recognized genera, but endeavour to detect other generic characters, and ascertain what predicates are attached to them, and to what subjects they are attached. A class of animals is horned, and characterized by a ruminating apparatus and the absence of teeth in the upper jaw. If we know what animals are the subject of this predicate, the possession of horns, this character,[2] the possession of horns, is the cause and explanation of their possessing the other characteristics.

§ 3. We must also observe analogies: there is no common

[1] The collection of premisses, whether, as here, Scientific Theses, or Dialectical Organa, or Rhetorical specific data, is expressed by the word ἐκλέγειν or ἐκλαμβάνειν. Topics, i. 12; Prior. Anal. i. 27; Rhet. ii. 22.

[2] See De Part. Anim. iii. 2. and iii. 14. The explanation here given is, that the horns exhaust the material that might have formed the upper teeth; and, as thereby the mastication is incomplete, to assist the digestive process, nature provides the ruminating apparatus, a kind of secondary stomach.

name for the spine of fish, the pounce of the sepia, and the common bone, but they all have the same concomitant attributes, evincing a unity of nature.

§ 4. Identity of problem is constituted by identity of the explanatory intermediate;[1] as several problems are explained by the development of an opposite by its opposite; and here the intermediate, though the same in genus, may differ in subject or in mode. The echo, the image in a mirror, the rainbow, are caused by refraction, generically the same, but different in species.

§ 5. Or problems are identical, if the explanatory middle of the one is subordinate to the explanatory middle of the other. The Nile swells at the close of the month, because the weather is stormy; the weather is stormy because the moon wanes: these causes are subordinate.

CHAPTER XIV.

RECIPROCATION OF CAUSE AND EFFECT.

§ 1. As the presence of an effect implies the presence of its cause: for if the fall of the leaf and the moon's eclipse do not imply the leaf's broadness and the earth's interposition, their origin must be due to other causes: and as the presence of the cause, the broadness of the leaf, or the interposition of the earth, implies the presence of the effect, the fall of the leaf or the moon's eclipse: the cause and effect are simultaneous, and the cause is deducible from the effect as well as the effect from the cause. Let A be the fall of the leaves, B broadness of the leaves, C the vine. Because A is predicated of B, and B of C, therefore A is predicated of C, and B the intermediate is the cause. Again, the broadness of the vine-leaves is deducible from their annual fall. Let D be broad-leaved, E shedder of leaves, F the vine. All F is E, and all E is D, therefore all F

[1] See the Meteorics, where he proposes to explain a great variety of phænomena by very few causes.

is D. In this case, however, the intermediate E is not the cause, for causation implies priority, and cannot be reciprocal. As interposition is the cause of eclipse, and not eclipse of interposition, and a reasoned or explanatory proof employs the cause, a deduction of the latter kind is not a reasoned proof, but only a proof of fact. Interposition is the cause of eclipse, and not *vice versa*, for it enters into the definition of eclipse, and renders it cognizable.

§ 2. If, however, the same term may be the primary predicate of several subjects, may not the same effect arise from several causes? Let A be a primary predicate of both B and C, and B of D, and C of E. A then is a predicate of D and E by the respective causation of B and C. The existence, it would appear, of the cause involves the existence of the effect; but the existence of the effect only involves the existence of one among several possible causes. If, however, the theorem is commensurate, the effect will be commensurate to the cause. The fall of leaves must be explained of its commensurate subject, whether a whole class or a species, whether the whole vegetable kingdom or a particular province: so that the cause or intermediate will be equal in extent and convertible with the effect or major. If the fall of leaves is produced by coagulation, wherever there is a fall there must be coagulation, and wherever there is coagulation of sap there must be a fall of leaves.

§ 3. There is only one cause from which an effect can be deduced, if the demonstration is essential;[1] for then the middle is

[1] "The ideal limit, therefore, of the explanation of natural phænomena (towards which, as towards other ideal limits, we are constantly tending, without the prospect of ever completely attaining it) would be to show that each distinguishable variety of our sensations, or other states of consciousness, has only one sort of cause . . . . As long as there are several known modes of production of a phænomenon, so long it is not impossible that one of these modes of production may be resolved into another, or that all of them may be resolved into some more general mode of production not hitherto recognized. But when the modes of production are reduced to one, we cannot, in point of simplification, go any further . . . Accordingly the greatest achievements in physical science have consisted in resolving one observed law of the production of motion into the laws of other known modes of production,

the definition of the effect or major. The same effect is susceptible of many deductions by sign or accident: both the major and the minor premiss, both the conjunction of effect and cause, and of cause and material, may be accidental; but such propositions are useless in a scientific theorem.

§ 4. The premisses resemble the theorem; if it is equivocal, the premisses are equivocal; if it is incommensurate, they are incommensurate. The cause of the convertibility of a proportion is both different and identical for proportional lines and proportional numbers; different so far as they are lines and numbers; identical so far as they receive the same increments.

§ 5. If one cause can be given why colour is similar to colour, and figure to figure, it must be equivocal; for similarity of figure is analogy of sides and equality of angles; and similarity of colour is production of the same sensation, or whatever else may be its definition.

§ 6. If effects are analogous, the intermediates by which they are deduced are analogous.

§ 7. There is a reciprocal sequence between the major, the middle, and the minor terms, the effect, the cause, and the material. The major is more extensive than any particular minor, but equal to the universal class: the equality of exterior angles to four right angles is more extensive than triangle or square, but equal to the whole class of plane rectilinear figures: and the relation of the middle to the extremes is similar.

§ 8. The middle is the definition of the major; therefore definitions are the basis of a science. The fall of the leaf is an attribute of the vine, but more extensive; of the fig, but more extensive: it is co-extensive to some class in which they are all embraced. The primary intermediate defines the fall of the leaf, the attribute or major: not Broad-leaved, the primary in-

or the laws of several such modes into one more general mode; as when the fall of bodies to the earth, and the motions of the planets, were brought under the one law of the mutual attraction of all particles of matter; when the motions said to be produced by magnetism were shown to be produced by electricity; when the motions of fluids in a lateral direction, or even contrary to the direction of gravity, were shown to be produced by gravity; and the like."—System of Logic, book iii. 14.

termediate next the subject, which is only a class including all leaf-shedding trees: but the intermediate next the effect or attribute—coagulation of sap, or whatever else it may happen to be. Leaf-shedding is defined by the coagulation of the sap at the junction of the stalk and stem.

§ 9. To examine with symbols the incommensurate sequence of cause and effect, assume the propositions,

all B is A
all D is B:

where A the effect is universal to B the cause, but not its primary or coextensive universal: and B the cause is universal to C the subject, but not its primary or coextensive universal. As B is not the only cause of A, let us assume other propositions:

all C is A
all E is C;

where the terms are similarly related. If neither B nor C is commensurate to A, they must be mutually exclusive: for any genus that contained all the causes of A would be commensurate to A, which is contrary to hypothesis.

The same effect, then, may be produced by different causes, but only in subjects specifically different. Longevity may be due to the absence of gall in Quadrupeds: in Birds to the predominance of solids, or whatever else the cause may be.

§ 10. If a subject does not fall at once under the term indivisibly connected with the attribute, but is separated from it by several intermediates, all these intermediates are causes of its possessing the attribute.

§ 11. Which is properly called its cause? the intermediate immediately adjoining the universal or attribute, or the one immediately adjoining the subject? The one adjoining the subject is the cause that the primary or subject falls under the universal or attribute. If D is C, and C is B, and B is A; C is the cause that conjoins the effect A to the subject D, because it conjoins B to D; B is the cause that conjoins the effect A to the subject C; and B is the cause of its own conjunction with A.

CHAPTER XVI.

THE ORGAN OF PRIMARY TRUTHS.

§ 1. Such is the nature and origin of syllogism and demonstration, and, what is the same as the latter, of demonstrative science.

Let us now proceed to consider the method and the faculty by which elementary principles are recognized. Demonstrative science, as we saw, is based on a knowledge of primary immediate principles. Is the mode of knowing the immediate identical with the mode of knowing the mediate? Is it Science, or something different in kind? Are the appreciating faculties acquired, or are they innate, though unobserved?

§ 2. They cannot be innate: we can scarcely have a knowledge more perfect than demonstration, and yet be unconscious of it. If they are acquired, we saw, when treating of demonstration, that we cannot learn and acquire knowledge without a basis of previous knowledge. As, then, they are neither innate, nor acquirable without a basis of previous knowledge and perceptions, some developed power must be innate of inferior perfection and excellence to the faculties of the immediate.

§ 3. Such we find in all animals: all have an innate perceptive power which we call Sense. In some the sensation is transient; and these have no knowledge, at least of the objects whose impression is transitory, beyond sensation. Others retain the sensation, and these are subdivided; for in some of them a number of permanent sensations developes an intellectual conception.

On sensation, then, ensues memory; and on many memories of the same fact Experience: for many similar memories are one Experience: on Experience, or the whole unchanging universal that has settled in the mind, the all-permeating One beside the Many, ensues the beginning of Art and Science; of

Art if the end is production, of Science if the end is truth.[1] The faculties, then, are neither innate and originally developed, nor preceded by any higher cognizant power, but by Sense.

§ 4. In a battle, when an army is taking to flight, first one man makes a stand, and then another, and another, till they recover their original order:[2] the soul is adapted for undergoing a similar process: and we may now repeat more distinctly what we said before. So soon as an individual makes a stand in the mind, we have the primary or lowest universal; for, though sensation perceives Callias, the individual, sense perceives Man, the universal: in these lowest universals, higher universals make a stand; and finally the indecomposable and highest universals: first a kind of animal, then animal, and then a higher genus. Man's knowledge of the elementary, it appears, is inductive; for the way that sense imparts the universal is inductive.

§ 5. Our intellectual faculties are either fallible, as Opinion and Reasoning, or infallible, as Science and Reason. As all science implies conclusion, principles are not objects of science. As principles are more evident than conclusions, and no power except Reason has greater light and insight than Science, principles are the objects of Reason.

Again, as the basis of demonstrated truth is not demonstrated truth, so science is not the basis of science. If Reason is the only infallible faculty besides Science, Reason must be the

[1] With *ἠρεμήσαντος τοῦ καθόλου* compare, *τῷ γὰρ ἠρεμῆσαι καὶ στῆναι τὴν διάνοιαν ἐπίστασθαι καὶ φρονεῖν λεγόμεθα . . . τῷ γὰρ καθίστασθαι τὴν ψυχὴν ἐκ τῆς ἠθικῆς ἀρετῆς φρόνιμόν τι γίνεται καὶ ἐπιστῆμον . . . καθίσταται δὲ καὶ παύεται τῆς ταραχῆς τότε μὲν ὑπὸ τῆς φύσεως τότε δ' ὑπ' ἄλλων.* Phys. Ausc. vii. 3. *τῶν ἀκινήτων ὅρων καὶ πρώτων.* Nic. Ethic. vi. 11. *ἵστησι γὰρ ὁ λέγων τὴν διάνοιαν καὶ ὁ ἀκούσας ἠρέμησεν.*—De Interp. 3.

ἄμφω κινοῦσιν αἱ δόξαι, ἀλλ' ἡ μὲν καθόλου ἠρεμοῦσα μᾶλλον, ἡ δὲ οὔ.—De Animâ, iii. 11.

[2] The drift of this simile is obscure: it may mean, that as order succeeds to the disorder of flight, so the ordering ideas succeeds to the confusion of phænomena; and as the routed army could not have assumed its second array but for its former organization, so the regulating ideas could not appear in the mind, unless there were in nature behind the confusion of phænomena an original order and law.

basis or beginning of Science:[3] and the beginning of Science bears the same relation to the basis or beginning of truth, that the whole body of science bears to the whole body of truth.

[3] ἀρχὴν ἐπιστήμης εἶναί τινα φαμὲν, ᾗ τοὺς ὅρους γνωρίζομεν.—Post. Anal. i. 3. ἡ ἀρχὴ ἐν βάρει μὲν μνᾶ, ἐν δὲ μέλει δίεσις, ἐν δὲ συλλογισμῷ τὸ ἓν πρότασις ἄμεσος, ἐν δ' ἐπιστήμῃ ὁ νοῦς.—Ibid. i. 23.

APPENDIX.

APPENDIX A.

AXIOMS.

§ 1. An Axiom is a principle not limited to any one department of nature, but equally applicable to every subject-matter.[1] The leading Axiom is expressed under various formulæ. In the Metaphysics we have,[2] One of two contradictories must be true; and, The same thing cannot be and not be. In the Prior Analytics,[3] The same subject cannot have contradictory predicates; and, Every subject must have one of two contradictory predicates. In the Treatise on Fallacies,[4] Things which are the same as the same are the same as one another.

§ 2. It is clear that if this principle were not true, if it were possible that the propositions, A is B, and A is not-B, could stand together, there could be no reasoning and no thought. Accordingly those who denied the possibility of Knowledge or Philosophy, in order to do their work thoroughly, selected this principle as the object of their attack. To effect its overthrow various doctrines of celebrated philosophers were brought to bear.

Heraclitus, for instance, had said that all nature is in a perpetual flux, so that nothing is in the same state for two successive moments.[5] From this it would follow that neither of two contradictories could be predicated with truth of any subject.

[1] κοινόν.—Anal. Post. passim.

[2] πᾶν ἀναγκαῖον ἢ φάναι ἢ ἀποφάναι, καὶ ἀδύνατον ἅμα εἶναι καὶ μὴ εἶναι.—Met. iii. 2.

[3] φάσις καὶ ἀπόφασις οὐχ ὑπάρχουσιν αἱ ἀντικείμεναι ἅμα τῷ αὐτῷ. . . . κατὰ παντὸς ἑνὸς ἢ φάσις ἢ ἀπόφασις ἀληθής.—Prior. An. i. 40.

[4] τὰ ἑνὶ καὶ ταὐτῷ ταὐτὰ καὶ ἀλλήλοις ἀξιοῦμεν εἶναι ταὐτά.—Soph. Elench. 6. Perhaps the most ancient formula is the line of Parmenides: οὐ γὰρ μήποτε τοῦτο δαῇς, εἶναι μὴ ἐόντα.—Plato, Sophistes.

[5] Met. iv. 5.

Anaxagoras held that the ultimate elements could never be entirely separated;[1] that nothing in nature was pure or simple, or excluded opposite elements, but received its denomination according to the predominance of particular ingredients. It follows, that neither of two contradictories can be predicated absolutely of any subject. He maintained also, that whatever seems is true;[2] an assertion similar to that of Protagoras, who taught that man is the measure of reality, which meant that opinion is the criterion of truth;[3] and, as the same objects produce different sensations and opinions in different men, it was inferred that truth may be self-contradictory.

To avoid the consequences of the doctrine of Heraclitus,[4] Plato, who came from this school, maintained the existence of immutable Ideas.

§ 3. As all the sciences alike assume the truth of the Axioms,[5] it does not appear to which of them the discussion properly belongs, and this is proposed as a question in the Metaphysics; where it is decided, that, as they are true of all Being, they belong to the science of Being, and accordingly they are discussed by Aristotle in the Metaphysics.[6]

§ 4. The Axioms are indemonstrable; for it is impossible

[1] *ὁμοῦ πάντα χρήματα, ὥστε μηδὲν ἀληθῶς ἓν ὑπάρχειν.*—Met. iv. 4. *μεμίχθαι πᾶν ἐν παντί.*—Met. iv. 5. *ἐν παντὶ παντὸς εἶναι μοῖραν.*—Met. xi. 6. *εἰλικρινῶς μὲν γὰρ ὅλον λευκὸν ἢ μέλαν οὐκ εἶναι, ὅτου δὲ πλεῖστον ἕκαστον ἔχει, τοῦτο δοκεῖν εἶναι τὴν φύσιν τοῦ πράγματος.*—Physic. Ausc. i. 4. *ὅτε γὰρ οὐδὲν ἦν ἀποκεκριμένον, δῆλον ὡς οὐδὲν ἦν ἀληθὲς εἰπεῖν κατὰ τῆς οὐσίας ἐκείνης.*—Met. i. 7.

[2] *Ἀναξαγόρου δὲ καὶ ἀπόφθεγμα μνημονεύεται πρὸς τῶν ἑταίρων τινάς, ὅτι τοιαῦτα αὐτοῖς τὰ ὄντα, οἷα ἂν ὑπολάβωσι.*—Met. iv. 5.

[3] *ἐκεῖνος ἔφη πάντων εἶναι χρημάτων μέτρον τὸν ἄνθρωπον· οὐδὲν ἕτερον λέγων, ἢ τὸ δοκοῦν ἑκάστῳ τοῦτο καὶ εἶναι παγίως.*—Met. xi. 6; also Met. iv. 5. *καὶ σοί, ἐάν τε βούλῃ, ἐάν τε μή, ἀνεκτέον ὄντι μέτρῳ.*—Plato, Theæt. § 64. *αὐτάρκη ἕκαστον εἰς φρόνησιν ἐποίει.*—Ibid. § 69.

[4] *ὥστ', εἴπερ ἐπιστήμη τινὸς ἔσται καὶ φρόνησις, ἑτέρας δεῖν τινὰς φύσεις εἶναι παρὰ τὰς αἰσθητὰς μενούσας· οὐ γὰρ εἶναι τῶν ῥεόντων ἐπιστήμην.*—Met. xiii. 4.

[5] *πᾶσαι γὰρ αἱ ἀποδεικτικαὶ χρῶνται τοῖς ἀξιώμασιν.*—Met. iii. 2.

[6] *ἐπεὶ δῆλον ὅτι ᾗ ὄντα ὑπάρχει πᾶσι, τοῦ περὶ τὸ ὂν ᾗ ὂν γνωρίζοντος καὶ περὶ τούτων ἐστὶν ἡ θεωρία.*—Met. iv. 3. *ὅτι μὲν οὖν τοῦ φιλοσόφου καὶ τοῦ περὶ πάσης τῆς οὐσίας θεωροῦντος ᾗ πέφυκε καὶ περὶ τῶν συλλογιστικῶν ἀρχῶν ἐστὶν ἐπισκέψασθαι, δῆλον.*—Ibid.

that every truth should be demonstrated, as this would imply an infinite series of demonstrations; and there is no truth that has a higher claim than the Axiom to be received on its own evidence.[1] To deny them is to deny the possibility of reasoning;[2] to attempt to prove them would be to make a *petitio principii*, as they are involved in all proof.[3] Besides, all Demonstration implies a subject of which a predicate is demonstrated, and Axioms whereby it is demonstrated; and how can the Axioms themselves be susceptible of this further analysis?[4] They can only be dialectically maintained; that is, if the opponent grants us any premisses, it would not be difficult to show a number of absurdities that flow from his Thesis:[5] and then he is responsible for the *petitio principii*, as the propositions are of his own concession.[6] The mode of argument should be, to demand a verbal definition of any subject, and then to show that it has some predicate, and excludes its contradictory.[7]

The doctrine of the Sceptics is self-destructive;[8] for if we

[1] *αὕτη δ' ἁπασῶν ἐστι βεβαιοτάτη τῶν* 'Αρχῶν.—Met. iv. 3.

οὐ γάρ ἐστιν ἐκ πιστοτέρας ἀρχῆς αὐτοῦ τούτου ποιήσασθαι τὸν συλλογισμόν.—Met. xi. 5.

εἰ δέ τινων μὴ δεῖ ζητεῖν ἀπόδειξιν, τίνα ἀξιοῦσιν εἶναι μᾶλλον τοιαύτην ἀρχήν, οὐκ ἂν ἔχοιεν εἰπεῖν. Met. iv. 4. *λόγον γὰρ ζητοῦσιν ὧν οὐκ ἔστι λόγος· ἀποδείξεως γὰρ ἀρχὴ οὐκ ἀπόδειξίς ἐστιν.*—Met. iv. 6.

[2] *ἀνῄρηται τὸ διαλέγεσθαι πρὸς ἀλλήλους· κατὰ δὲ τὴν ἀλήθειαν καὶ πρὸς αὑτόν· οὐδὲν γὰρ ἐνδέχεται νοεῖν μηθὲν νοοῦντα ἕν.*—Met. iv. 4.

[3] *ὁ ἀποδεικνύων ἂν δόξειεν αἰτεῖσθαι τὸ ἐν ἀρχῇ.*—Met. iv. 4.

[4] *εἰ δ' ἀποδεικτικὴ περὶ αὐτῶν ἐστι, δεήσει τι γένος εἶναι ὑποκείμενον, καὶ τὰ μὲν πάθη, τὰ δ' ἀξιώματα αὐτῶν· ἀνάγκη γὰρ ἔκ τινων εἶναι, καὶ περί τι, καί τινων, τὴν ἀπόδειξιν.*—Met. iii. 2.

[5] *ἔστι δ' ἀποδεῖξαι ἐλεγκτικῶς, ἂν μόνον τι λέγῃ ὁ ἀμφισβητῶν.*—Met. iv. 4.

οὐ ῥᾴδιον διαλῦσαι μὴ τιθέντων τι καὶ τούτων μηκέτι λόγον ἀπαιτούντων. μηδὲν γὰρ τιθέντες ἀναιροῦσι τὸ διαλέγεσθαι καὶ ὅλως λόγον.—Met. xi. 6.

[6] *αἴτιος οὐχ ὁ ἀποδεικνὺς ἀλλ' ὁ ὑπομένων· ἀναιρῶν γὰρ λόγον ὑπομένει λόγον.*—Met. iv. 4. Compare, Alii autem negabant se pro hac evidentiâ quidquam priores fuisse dicturos; sed ad ea quæ contra dicerentur dici oportere putabant.—Academica Priora, ii. 6.

[7] *ἀρχὴ δὲ πρὸς ἅπαντας τούτους ἐξ ὁρισμοῦ.*—Met. iv. 7.

ὥστε ἐξ ὁρισμοῦ διαλεκτέον.—Met. iv. 8.

ἀρχὴ δὲ πρὸς ἅπαντα τὰ τοιαῦτα τὸ ἀξιοῦν σημαίνειν γέ τι.—Met. iv. 4.

[8] *συμβαίνει δὴ καὶ τὸ θρυλλούμενον πᾶσι τοῖς τοιούτοις λόγοις· αὑτοὺς ἑαυτοὺς ἀναιρεῖν.*—Met. iv. 8; also Met. xi. 7.

grant that contradictories are true together, it follows that the contradictory of this very doctrine is true, and that contradictories are not true together.

Against Heraclitus it must be maintained, that all things are not ever changing, but that in the midst of change there is something permanent and changeless:[1] against Anaxagoras, that, when a subject exchanges any predicate for its contradictory, the latter did not previously exist in it actually, but only potentially:[2] against Protagoras, that only the perfect sense or judgment is the criterion of truth, not any sense or judgment indiscriminately.[3]

Any doctrine can be verbally denied, but not always mentally disbelieved;[4] and, though some have maintained that contradictories can be true together, yet it may be demonstrated that they were belied by their own reason:[5] for, if it be objectively true that the same subject cannot have contradictory predicates, then, if we take judgment as a subject and belief as a predicate, it follows, that the same judgment cannot entertain two contradictory beliefs; and the consciousness of this inability is a recognition of the Axiom. Every understanding, then, recognizes the Axioms, which thus differ from the Hypotheses,[6] and are the indispensable condition of any opinion or science.[7]

[1] *ὅτι γάρ ἐστιν ἀκίνητός τις φύσις δεικτέον αὐτοῖς καὶ πειστέον αὐτούς.*—Met. iv. 5.

[2] *τὸ ἀόριστον ἐοίκασι λέγειν .... τὸ γὰρ δυνάμει ὂν καὶ μὴ ἐντελεχείᾳ τὸ ἀόριστόν ἐστι.*—Met. iv. 4; also Met. i. 7.

[3] *ἐφθαρμένων καὶ λελωβημένων τῶν ἑτέρων τὸ αἰσθητήριον καὶ κριτήριον, τοὺς ἑτέρους μὲν ὑποληπτέον μέτρον εἶναι, τοὺς δ' ἑτέρους οὐχ ὑποληπτέον. ὁμοίως δὲ τοῦτο λέγω καὶ ἐπὶ ἀγαθοῦ καὶ κακοῦ καὶ καλοῦ καὶ αἰσχροῦ καὶ τῶν ἄλλων τῶν τοιούτων.*—Met. xi. 6.

[4] *ἀεί ἐστιν ἐνστῆναι πρὸς τὸν ἔξω λόγον, ἀλλὰ πρὸς τὸν ἔσω λόγον οὐκ ἀεί.*—Anal. Post. i. 10.

[5] *ἀρχὴ περὶ ἣν διαψευσθῆναι ἀδύνατον . . . εἰ γὰρ μὴ ἐνδέχεται ἅμα ὑπάρχειν τῷ αὐτῷ τὰ ἐναντία δ' ἐστὶ δόξα δόξῃ ἡ τῆς ἀντιφάσεως, φανερὸν ὅτι ἀδύνατον ἅμα ὑπολαμβάνειν τὸν αὐτὸν εἶναι καὶ μὴ εἶναι τὸ αὐτό.*—Met. iv. 3.

[6] *ἀρχὴ ἀνυπόθετος· ἣν γὰρ ἀναγκαῖον ἔχειν τὸν ὁτιοῦν συνιέντα τῶν ὄντων, τοῦτο οὐκ ὑπόθεσις.*—Ibid.

οὐκ ἔστι δ' ὑπόθεσις ὃ ἀνάγκη εἶναι δι' αὐτὸ καὶ δοκεῖν ἀνάγκη.—Post. Anal. i. 10.

[7] *ἣν ἀνάγκη ἔχειν τὸν ὁτιοῦν μαθησόμενον, ἀξίωμα.*—Post. Anal. i. 2. *ὃ δὲ γνωρίζειν ἀναγκαῖον τῷ ὁτιοῦν γνωρίζοντι, καὶ ἥκειν ἔχοντα ἀναγκαῖον.*—Met. iv. 3.

§ 5. How do the Axioms enter science, of which they are said to be the common principles? Not as propositions or premisses, but as the principle of syllogism by which we pass from premisses to a conclusion.

We may show that the Axiom: The same thing cannot have contradictory predicates, is equivalent to the *dictum de omni et nullo*, by applying it to the two first moods of the first figure. For in the affirmative syllogism,

all B is A
all C is B
∴ all C is A,

the major premiss may be considered as assigning A, one of two contradictory predicates, to B; the minor as recognizing the identity of B and C; and the conclusion as affirming, in virtue of the Axiom, that C cannot possess the contradictory of A. A negative syllogism can be analyzed in the same manner. In the syllogism,

no B is A
all C is B
∴ no C is A,

the major premiss ascribes not-A, one of two contradictories, to B; the minor recognizes the sameness of B and C; and the conclusion, by faith in the Axiom, denies the other contradictory of C. The explanation will slightly vary according as we take different forms of the Axiom.

Their equivalence to the *dictum de omni et nullo* appears to have been held by Aristotle from his calling them the Syllogistic principles, or the Demonstrative principles:[1] and he seems to mean that they are not employed as premisses, when he says that they are not expressed but only implied, unless the conclusiveness of an argument is called in question.[2]

[1] *περὶ τῶν ἀποδεικτικῶν ἀρχῶν· λέγω δ' ἀποδεικτικὰς, καὶ τὰς κοινὰς δόξας ἐξ ὧν ἅπαντες δεικνύουσι.*—Met. iii. 2. *περὶ τῶν συλλογιστικῶν ἀρχῶν τοῦ φιλοσόφου ἐστὶν ἐπισκέψασθαι.*—Met. iv. 3.

[2] *οὐδεμία λαμβάνει ἀπόδειξις ἀλλ' ἢ ἐὰν δέῃ δεῖξαι καὶ τὸ συμπέρασμα οὕτως.*—Post. Anal. i. 11. Compare *οὐδ' ἐν συλλογισμῷ λαμβάνεται τί ἐστι τὸ συλλελογίσθαι· ἀεὶ γὰρ ὅλη ἢ μέρος ἡ πρότασις ἐξ ὧν ὁ συλ-*

To make the Axioms major premisses would be to give some colour to the imputation sometimes cast upon Logic, that she teaches a cumbrous mode of reasoning of her own, not that which is taught by nature and practised by the unsophisticated understanding.

Though barren of consequences themselves, the Axioms enable us to educe the consequences of other truths; and though alone they are insufficient, it would be a mistake to suppose that we could dispense with their assistance: hence there is an inaccuracy in the following passage of Locke, which is otherwise perfectly Aristotelian in its view. "It was not," he says, "the influence of those maxims which are taken for principles in Mathematics that hath led the masters of that science into those wonderful discoveries they have made. Let a man of good parts know all the maxims generally made use of in Mathematics never so perfectly, and contemplate their extent and consequences as much as he pleases, he will by their assistance, I suppose, scarce ever come to know that the square of the hypothenuse in a right angled triangle is equal to the squares of the two other sides. The knowledge that the whole is equal to all its parts, and, if you take equals from equals the remainders will be equal, *helped him not*, I presume, to this demonstration: and a man may, I think, pore long enough on those axioms, without ever seeing one jot the more of mathematical truths." Essay on Human Understanding, Book iv. chap. 12, § 15. Again, "The axioms are not the foundations on which any of the sciences is built; *nor at all useful in helping men forward* to the discovery of unknown truths."—Book iv. chap. 7, § 11. It is true that poring on the Axioms alone would not enable us to discover mathematical truths, but it does not for all that follow that they are utterly useless.[1] Though unproductive themselves, they help us to unfold the results of more prolific data: and without them we could not make a

λογισμός· δεῖ δὲ πρὸς τὸν ἀμφισβητοῦντα εἰ συλλελόγισται ἢ μὴ τοῦτο, ἀπαντᾶν, ὅτι· τοῦτο γὰρ ἦν συλλογισμός.—Post. Anal. ii. 6.

[1] *ἀλλ' οὐδὲ τῶν κοινῶν ἀρχῶν οἷόν τ' εἶναί τινας ἐξ ὧν ἅπαντα δειχθήσεται· τὰ γὰρ γένη τῶν ὄντων ἕτερα· καὶ τὰ μὲν τοῖς ποσοῖς τὰ δὲ τοῖς ποιοῖς ὑπάρχει μόνοις, μεθ' ὧν δείκνυται διὰ τῶν κοινῶν.*—Post. Anal. i. 32.

single step in deduction, as they constitute in fact the deductive faculty. Dugald Stewart recognized the distinction between Axioms and Theses, the latter of which he calls First Principles, the former Laws of Belief.—(Philosophy of the Human Mind, part 2, chapters 1, 2.)

Mr. Whewell's Axioms are very different from those of Aristotle. Sometimes they are equivalent to Hypotheses (book x. 5): sometimes they contain more than the Hypothesis, being supplementary to the Definitions where these are inadequate; sometimes the word is used in the stricter sense. Yet, though thus peculiar in his use of the term, he censures Locke and Stewart, who affixed a very different meaning to it, for calling the Axioms barren truisms. This is true in the sense in which they employed the term. The Axioms are themselves barren and fruitless, their office being to cause the Theses to fructify. In Dialectics and Rhetoric a similar relation obtains between the Topics and the Organa, or specific premisses.

§ 6. The Axiom is not used in all its generality whenever employed, but only so far as it regards the subject-matter under discussion:[1] in Mathematics, for instance, it does not contain the notion of Identity, but only the Mathematical form of this, Equality.

The existence and character of the Axioms is indicated by Logic; and the laws of reasoning, as traced by General Logic, may be considered as the development of their simplest form: they are used by all the sciences:[2] they are discussed and defended by Metaphysics; and are characteristic of Dialectics.

The Dialectical Maxims or Topics are modifications of the Axioms, and obtainable by deduction;[3] for they appear to be the derivative Axioms to which Aristotle alludes.

[1] χρῶνται μὲν πάντες, ἐπὶ τοσοῦτον δὲ χρῶνται ἐφ' ὅσον αὐτοῖς ἱκανόν· τοῦτο δ' ἔστιν ὅσον ἐπέχει τὸ γένος περὶ οὗ φέρουσι τὰς ἀποδείξεις. ..Met. iv. 3; also Anal. Post. i. 10.

[2] ἐπικοινωνοῦσι δὲ πᾶσαι αἱ ἐπιστῆμαι ἀλλήλαις κατὰ τὰ κοινά, καὶ ἡ διαλεκτικὴ πάσαις, καὶ εἴ τις καθόλου πειρῷτο δεικνύναι τὰ κοινά.—Anal. Post. i. 11.

[3] φύσει γὰρ ἀρχὴ καὶ τῶν ἄλλων ἀξιωμάτων αὕτη πάντων.—Met. iv. 3. The same is asserted by Sir Wm. Hamilton. "For every maxim of every Dialectical Place is itself contained within the sphere of one or

It is the Axiom, the principle that one of two contradictories must apply to every subject, that constitutes the necessity of Division.[1]

§ 7. Some have assigned all primary truths to Metaphysics: this cannot be, unless it is the sole science; for all science rests on a basis of primary laws. But though, in resting on Theses, Metaphysics only resembles its sister sciences, it stands in a peculiar relation to the Axioms. The others investigate as well as use their respective Theses, but employ the Axioms without submitting them to an investigation; for as these principles are laws of all Being, their investigation belongs to the science of Being, that is, to Metaphysics or Ontology: by Metaphysics, therefore, they are investigated as well as employed.

Logic will take cognizance of the Axioms, as, to a certain degree, it takes cognizance of all truths. An Astronomical conclusion, so far as it is a conclusion, obeys certain Logical canons; so far as it regards the heavenly bodies, it belongs to Astronomy. In the same way Astronomical principles, so far as they are principles, exhibit certain Logical attributes: so far as they refer to the Stars, they are Astronomical. And Logic stands in a similar relation to the conclusions and principles of all other sciences, Metaphysics included, whether the principles are Theses or Axioms. Though the latter, then, are peculiarly the province of Metaphysics, yet to a certain degree, as well as all other truths, they would fall under the cognizance of Logic.

But a much closer relation than this subsists between the Axioms and Logic. They are the principles involved in all reasoning, (called, as we have seen, by Aristotle, συλλογιστικαὶ ἀρχαὶ, and ἀποδεικτικαὶ ἀρχαί) that is, they are the very principles whose consequences and limitations are traced by General Logic. Metaphysics undertakes their justification and defence against all assailants; Logic assumes them as self-evident, and

other of the four logical laws, of Identity, Contradiction, Excluded Middle, and Reason and Consequent, of which it is only a subordinate modification."—See Sir W. H.'s edition of Reid, p. 767. Fichte professes to elicit a great variety of conclusions from the Axiom.

[1] τὸ δ' ἅπαν ἐμπίπτειν εἰς τὴν διαίρεσιν ἂν ᾖ ἀντικείμενα, οὐκ αἴτημα, ἀνάγκη γάρ.—Anal. Post. ii. 12.

developes them into the forms of argument and the canons of syllogism. Through the Axioms, then, Logic is more closely related to Metaphysics than to the other sciences: it criticizes both it and them: but while independent of the latter, it borrows from the former some of its ultimate principles.

APPENDIX B.

HYPOTHESES.

§ 1. An Hypothesis is a peculiar principle,[1] that is, it differs from an Axiom, in that it varies in different sciences; and is the element that gives a categorical character to the conclusions, by affirming the reality of the first cause whose effects are deduced, or of the substance whose attributes are proved.[2] Had we merely definitions of the cause and the effect, of the substance and the attribute, we might indeed demonstrate their respective connection. But such an effect and attribute would be purely ideal and imaginary: we should not know their reality or actual existence, a knowledge that is essential to the completeness of science. If, however, we know the actual existence of the first cause or the substance, then by the aid of definitions we can not only evince the indissoluble connection of the effect and attribute with such cause and substance, but also their actual and real existence. The existence of the effect and attribute is not assumed in the Hypothesis:[3] to prove it is the work, and the sole work of Demonstration, for their nature, or essential character, is assumed in the Definitions.

§ 2. It must be observed, that Hypothesis sometimes appears to signify the contrary of what has been stated; for a conclu-

[1] *ἰδία* or *οἰκεία ἀρχή. ἔστι δ' ἴδια καὶ ἃ λαμβάνεται εἶναι.*—Post. Anal. i. 10.

[2] *θέσις ἡ τὸ εἶναί τι ἢ μὴ εἶναί τι λαμβάνουσα, ὑπόθεσις.*—Post. Anal. i. 2.

εἶναι τὰ ἄμεσα καὶ τὰς ἀρχας ὑποθέσθαι δεῖ.—Post. Anal. ii. 8. It is inaccurate to use Hypothesis for definition, as appears from Post. Anal. i. 2. *ὅτι δ' ἔστι τὰς μὲν ἀρχὰς ἀνάγκη λαμβάνειν.*—Post. Anal. i. 10.

[3] *τὰ δὲ τούτων πάθη καθ' αὑτὰ τί μὲν σημαίνει ἕκαστον λαμβάνουσιν· ὅτι δ' ἔστι δεικνύουσι.*—Post. Anal. i. 10.

sion is said to be hypothetical in the absence rather than in the presence of the Aristotelian Hypothesis: in modern times a theory is called an Hypothesis before it is established as a Law—that is, while it consists of Definitions without Hypotheses; and Aristotle himself calls conditional conclusions hypothetical.[1] This perhaps may be accounted for from a characteristic of the Hypothesis that distinguishes it from the Axiom, its want of recognizable necessity.[2] Hence it seems to have been applied to propositions that have scarcely any evidence; and a conclusion that rested on such a premiss would be so far conditional, and, in reference to this premiss, hypothetical. There will be no confusion if we remember that when an Hypothesis is spoken of as a scientific principle, it means that element that renders conclusions unconditional and un-hypothetical.

§ 3. Three characteristics, then, are united in the conception of the Hypothesis: it is an appropriate principle; it asserts existence or reality; and its necessity is deficient in evidence. From this last peculiarity of existential propositions, some modern writers have maintained that the demonstrative sciences are hypothetical, not categorical.[3] Kant maintains that the existence of Space and Time are inevitably believed, and hence gives the mathematical sciences a categorical character. He considers that the want of evidence or subjective necessity in the Hypothesis of Natural Theology is an important objection against that science. But there is no apparent reason why a Being should not be possessed of necessary existence, though the necessity of its existence be not discoverable to the human mind. Aristotle merely observes that existential propositions vary in degrees of evidence.[4]

§ 4. Arts will be founded on Definitions alone, not on Hypo-

[1] Categorical and conditional are opposed as ἁπλῶς and ἐξ ὑποθέσεως. Post. Anal. i. 22.

See the distinction of categorical or absolute and hypothetical necessity. De Part. Anim. i. 1; also Physic. Ausc. ii. 9.

[2] οὐκ ἔστι δ' ὑπόθεσις ὃ ἀνάγκη εἶναι δι αὐτὸ καὶ δοκεῖν ἀνάγκη.—Post. Anal. i. 10.

[3] Dugald Stewart.

[4] τὸ γένος μὴ ὑποτίθεσθαι εἶναι ἂν ᾖ φανερὸν ὅτι ἐστίν· οὐ γὰρ ὁμοίως δῆλον ὅτι ὁ ἀριθμός ἐστι καὶ ὅτι θερμὸν καὶ ψυχρόν.—Post. Anal. i. 10.

theses: for the foundation of Productive reasoning is the conception of an end, which does not yet exist, but may exist if certain means are put into execution.[1] So the result of Moral deliberation is a conditional conclusion; it only asserts that a certain measure must be adopted if we wish to realize a certain end. It is the duty, however, of Moral Philosophy to show the possibility of this end, that is, not its actual, but its potential existence; which duty is performed when she establishes the freedom of the will. The will is the efficient cause by which the end may be realized; and the propositions which state its freedom may be regarded as the Ethical Hypothesis, asserting the potential existence of the Moral Good.

§ 5. Besides the Absolute Hypothesis, there is a Relative Hypothesis which is susceptible of proof, and therefore is not a genuine first principle;[2] it is assumed, however, as a principle, because the person to whom it is addressed is willing to accept it without proof. This appears to be the sense in which Plato uses the word, when he calls the principles of all but the primary science Hypotheses, meaning merely arbitrary points of departure, capable of deduction from higher principles.[3] Under this head would come what Bacon has called the Axiomata Media.

A primary law of any science can be analyzed into two elements; one of which defines the character of an original power, and the other affirms its existence. Though the latter of these is, properly speaking, the Hypothesis, yet it is sometimes used to denote the whole truth;[4] in which case, perhaps, greater prominence is given to the existence of the subject-matter than to its essence.

§ 6. The Aristotelian Hypothesis corresponds to what Mr.

[1] ἡ γὰρ ἀρχὴ τοῖς μὲν τὸ ὂν τοῖς δὲ τὸ ἐσόμενον—De Part. Anim. i. 1.

[2] Post. Anal. i. 10.

[3] τὸ μὲν ψυχὴ ζητεῖν ἀναγκάζεται ἐξ ὑποθέσεων, τὸ δ' αὖ ἕτερον ἐπ' ἀρχὴν ἀνυπόθετον ἰοῦσα.—Rep. vi. 19.

τὰς ὑποθέσεις ποιούμενος οὐκ ἀρχάς, ἀλλὰ τῷ ὄντι ὑποθέσεις, οἷον ἐπιβάσεις τε καὶ ὁρμάς.—Ibid. 20.

διὰ τὸ μὴ ἐπ' ἀρχὴν ἀνελθόντας σκοπεῖν ἀλλ' ἐξ ὑποθέσεων, νοῦν οὐκ ἴσχειν.—Ibid.

ἡ διαλεκτικὴ τὰς ὑποθέσεις ἀναιροῦσα ἐπ' αὐτὴν τὴν ἀρχὴν πορεύεται.—Ibid. vii. 13.

[4] ὥσπερ ἐν τοῖς μαθηματικοῖς αἱ ὑποθέσεις.—Eth. Nic. vii. 8.

Mill has called the Collocation of Causes, which is explained in the following passages:—

"This leads us to a conception which we shall find of great importance in the interpretation of nature; that of a Permanent Cause, or original natural agent. There exist in nature a number of permanent causes, which have subsisted ever since the human race has been in existence, and for an indefinite and probably enormous length of time previous. The sun, the earth and planets, with their various constituents, air, water, and the other distinguishable substances, whether simple or compound, of which nature is made up, are such permanent causes . . . We can give, scientifically speaking, no account of the origin of the permanent causes themselves. Why these particular natural agents existed originally and no others, or why they are commingled in such and such proportions, and distributed in such and such a manner throughout space, is a question we cannot answer . . . All phænomena, without exception, which begin to exist, that is, all except the primeval causes, are effects either immediate or remote of those primitive facts, or of some combination of them . . . The whole of the phænomena of nature were therefore the necessary, or in other words, the unconditional, consequences of the original collocation of the Permanent Causes."—System of Logic, book iii. 5.

"It is necessary here to remark, that in this resolution of the law of a complex effect, the laws of which it is compounded are not the only elements. It is resolved into the laws of the separate causes, together with the fact of their co-existence. The one is as essential an ingredient as the other; whether the object be to discover the law of the effect, or only to explain it. To deduce the laws of the heavenly motions, we require not only to know the law of a rectilineal and that of a gravitative force, but the existence of both these forces in the celestial regions, and even their relative amount. The complex laws of causation are thus resolved into two distinct kinds of elements: the one simpler laws of causation, the other (in the aptly selected language of Dr. Chalmers) collocations; the collocations consisting in the existence of certain agents or powers, in certain circumstances of place and time."—Book iii. 12.

"Derivative laws, therefore, do not depend solely upon the

ultimate laws into which they are resolvable: they mostly depend upon those ultimate laws and an ultimate fact; namely, the mode of co-existence of some of the original elements of the universe. The ultimate laws of causation might be the same as at present, and yet the derivative laws completely different, if the causes co-existed in different proportions, or with any difference in those of their relations by which the effects are influenced."—Book iii. 16.

The ultimate laws of the Permanent causes assume, in the Aristotelian Logic, the form of Definitions: the ultimate fact of the existence of these causes, that gives an unconditional conclusion, is expressed in the Hypothesis; both are called Theses; and, combined with the developing Axioms, they are a sufficient basis of categorical science.

What Mr. Mill has called a Postulate is the Hypothesis. See note to Post. Anal. ii. 7.

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